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CONDUIT *v.* TROLLEY.

ON two or three occasions some reference has been made in these columns to certain proposals of the London County Council regarding electric tramways. In a sense, it is gratifying that the governing body of London should have become imbued with the desire to adopt an improved form of traction, but while one should rejoice at the determination of the County Council to sweep away the inefficient horse service which at present exists, there ought to be no hesitation in advancing criticisms against schemes which are unnecessarily expensive and far too elaborate for the needs of London. At the moment the County Council has done little more than enunciate a prineiple; it has not put forward any detailed scheme of traction, and for that reason close criticism would be premature. But we are told that as far as the Council is concerned, there is now no controversy about the method of traction to be employed. They have decided against the electric trolley and in favour of either the conduit or surface contact.

This definite and uncompromising statement proceeds from Mr. J. Allen Baker, a member of the London County Council, and as this gentleman accompanies his pronouncement with extravagant and unnecessary remarks about the trolley system, we consider it our duty to point out the fallaciousness of his arguments. Every man and every public body is entitled to an opinion, and equally justified in giving expression to it; but if the London County Council has determined to adopt a conduit system for reasons similar to those offered by Mr. Baker, then we unhesitatingly state that it is not fit to handle such a gigantic problem as that entailed in providing electric tramways for London. One can conceive, and even admit, objections against the overhead wire system in certain portions of central London; but the provision of electric tramways in the main streets of London is at the moment quite outside the province of the County Council; they are concerned only with those lines which connect the suburbs with the main approaches of London, and if it has been decided to equip such lines with either a surface contact or conduit system, then the governing body of London is going very much adrift, and does not deserve to enjoy the confidence of the electorate; moreover, we shall seek every opportunity of protesting against the unnecessary expenditure which such systems will entail.

We have full knowledge of the æsthetic objections against overhead wires, and probably overhead erections are not always desirable, but if the slight and eventually unnoticeable inconvenience of a light overhead structure will give an economical service at a moderate expenditure, then there is nothing in the London streets over which tramways operate, which calls for the elaborate and expensive construction necessary in any form of underground conduit. On the contrary, we should have thought

the condition of the London streets would have rendered such a system absolutely prohibitive. A Belfast Corporation deputation, which was appointed to go into this question, reported that "the difficulties that would be encountered in introducing an underground conduit system to the lower portions of Belfast, having regard to the position of sewers, covered river courses, gas and water mains, &c., the relation of street surfaces to high tide level, and the necessarily wide groove required in the rails, are so great, that the deputation cannot recommend its adoption." Is a Belfast deputation one whit less intelligent than a committee of the London County Council, or is the substructure of London streets different to that of Belfast? Neither the one nor the other: indeed, we doubt whether any city in the world possesses so amazing a complexity of pipework as prevails in the streets of the metropolis. Ask the officials of any gas, electric, or water company what is the real state of affairs, and we think the answer will be convincing enough. Why, the Council itself was compelled to abandon the project of an experimental conduit line in a certain district on account of two 30-inch water mains being laid down the centre! It would be necessary to move such pipes before a conduit could be constructed, and as matters now stand, the work would be obviously carried out by the owners of the pipes. As Mr. Clifton Robinson points out in the *Daily Mail*, the Council would have first to open up the street to find where the pipes were, and then it would have to wait the convenience of the gas or water company, which would do the work when it was most convenient to it, and then send in the bill of costs.

We will, however, leave for a moment the proposals of the County Council to deal with some of the statements which are credited by the *Daily Mail* to Mr. Baker. To quote from the interview which appeared in our contemporary, Mr. Baker says: "I felt sure from my knowledge as an engineer that the conduit should be cheaper to operate (leaving the initial cost of construction out of the question) than the trolley. In the trolley there must be a certain loss of electricity in working, which in a properly constructed conduit where both currents are conveyed by insulated bars, is avoided."

We do not wish to question Mr. Baker's knowledge as an engineer, but if he were acquainted with some elementary facts of the distribution of electricity he could scarcely have made such a statement. It is quite impossible to insulate an underground system so effectually as an overhead wire, for the simple reason that moisture collecting in the conduit will impair any method of insulation, and it may be taken for granted that on an average the consumption of current per car-mile will be slightly higher on a conduit than on an overhead system. The cost of operation includes, however, something more than that expended on current; there is the question of maintenance, and in a conduit there is the extra cost of cleaning. For instance, it may interest Mr. Baker to learn that on the Brussels conduit system, which is one of the best in Europe, the cost of cleaning the continuous accumulation of road silt and dirt from the conduit is put at £100 per annum per mile of single track. Mr. F. S. Pearson, who is the engineer to the large conduit scheme in New York, so much quoted by Mr. Baker, stated in a report to the Liverpool Corporation, that under Liverpool conditions of streets, the cost of cleaning the conduits per mile of track would probably amount to £40 per year. Now London is not as clean as either Brussels or Liverpool, and it may be taken, therefore, that the cost of cleaning per mile of track would not be less than £50 per mile, but there is another item which must not be lost sight of, and that is cost of maintenance, a very different matter in a conduit to what it is on an overhead system. It must be remembered that in the former there is a good deal of what is known as special work, such as at points and crossings, and the maintenance of this is a considerable item. Mr. Pearson, in the report alluded to, stated that the maintenance of special work in an overhead wire system would cost £60 per year per mile of track, but in an underground conduit system the maintenance cost per mile of track would be £180 per annum. If, therefore, the County Council in its vaulting ambition were to adopt 50 miles of conduit, it would have to pay something like £6,000 per annum for the maintenance of the special work alone, in order to keep the system in good condition, over and above the expenditure that would be incurred in an overhead wire system. This hardly bears out the statement that the conduit is cheaper to operate than the overhead system. At the same time Mr. Baker is at liberty to challenge these figures, and if he will do so in these columns and back up his contentions by giving chapter and verse, he will have the satisfaction of contributing some important information to the subject of electric traction.

After the somewhat curious statements to which we have alluded, it is not surprising that Mr. Baker should make much of the æsthetic objections against the overhead wire; this is, as a matter of fact, the very foundation on which the County Council bases its opposition to the overhead system; but we will ask a plain question in connection with this. Has the County Council ever made personal inquiries and examination of the conduit lines that exist on the European continent? Mr. Baker appears to have made some kind of private tour, but entirely on his own behalf and not in an official capacity, and at a later date the consulting engineer made investigations for the Council; but as far as we can learn the County Council has not thought fit to send a few of its members to Brussels, Berlin, Buda-Pesth and other places to obtain direct evidence as to the cost and the working of conduit lines. Yet cities like Manchester, Liverpool, Glasgow, Sheffield, where local government is as well understood as in London, did not consider themselves justified in adopting electric traction before collecting detailed information on the subject. Moreover, it must be remembered that the various municipal deputations which have examined the Continental practice started on their inquiries with a distinct bias against the overhead wire system. The Liverpool deputation stated that "before commencing their tour of inspection, [they] were impressed with the advantages of the underground conduit system, more especially as avoiding any obstruction from poles in the streets, and any unsightliness that might be caused by overhead wires. Their inspection and investigation have, however, convinced them that the mechanical construction of the underground conduit system is unsuitable for Liverpool roadways, with their heavy and crowded traffic, and where also the complicated tramway crossings would entail considerable constructive difficulties; that the system, electrically, is expensive to maintain, and liable to interruption;

and that in case of breakdown, the difficulty of access causes serious delays. In addition, from a sanitary point of view, an open conduit which cannot be effectively cleansed is objectionable." The deputation of the Manchester Corporation made most elaborate inquiries into the merits of the rival systems, and rejected the conduit on various grounds, and among other observations stated that "the underground slot system, though as simple to work as the overhead trolley, is very much more expensive, and possesses the serious disadvantage that it entails an entire cessation of traffic on the portion of line being converted for at least three weeks during its construction." Mr. Baker is not satisfied with drawing a somewhat fanciful picture of the appearance of overhead wires, but he goes so far as to say that the Board of Trade have decided that any overhead lines in London must have double return wires. This really shows how utterly inadequate is the information possessed by Mr. Baker on the subject, and we think he ought to apply to the Board of Trade before making statements which cannot be substantiated. Years ago we used to hear a good deal of the accidents caused by overhead wires, which, by the way, were chiefly used for lighting; but notwithstanding the numerous overhead systems on the Continent, and the fact that similar systems have been used in this country for some years without serious injury arising from fallen wires, Mr. Baker has the temerity to say that "You can find case after case in recent years where men and horses have been electrocuted by such wires breaking and falling." As a rule we should be disinclined to notice such an assertion, but when it proceeds from a person in Mr. Baker's position we must protest in the strongest possible manner against general statements of such a character. The public unfortunately is materially influenced by such language, and in the interests of electrical engineering we ask Mr. Baker to produce the records of such accidents. The question of accidents by means of falling wires was one to which municipal deputations especially addressed themselves, and in the whole of the reports that have come under our notice we can find no trace of a single fatal accident. And what has been the experience in this country? So far from men and horses being electrocuted, we can safely affirm that no person has been injured through a falling wire. Mr. Cunningham, who managed the Montreal Electric Tramways, says, "Instances of shock to any of the general public are extremely rare; in my five years' experience as manager of the Montreal Street Railway, where the system is worked by the overhead wire, I do not know of any one case." It is admitted by Mr. Baker that apart from the removal of street mains the cost of a mile of conduit would be a little over £12,000 per mile and the overhead wire £10,000 per mile of single track. We shall venture to dispute these figures in a moment, but we should like to give prominence to the fact that in a double track tramway the overhead structure costs very little more than that necessary in a single track, whereas in a conduit system on a double track it is necessary to provide two underground channels. But to make statements of cost of a conduit without taking into account the removal of street mains is wilfully shutting one's eyes to one of the most important items; all along our contention has been that in constructing a conduit in London streets, the heaviest expenditure will arise in making room for the conduit. It will be interesting, however, to give some facts concerning the cost of constructing conduits. Mr. Cunningham, in his report to the Liverpool Corporation, stated that "the works in the street cost at least twice as much as those of the overhead, and this, too, without regard to a very heavy cost, which cannot be estimated beforehand, in the moving of gas and water pipes." Mr. Pearson, who has had a larger experience in the construction of conduit systems than any man living, gave, in his report to the Liverpool Corporation, some actual details of cost of the two rival systems. For a single mile of straight track for the overhead wire the cost is stated to be £5,822, and for a single mile of slotted conduit the cost is put at £9,648. Mr. Connett, who was the engineer to the Washington and Baltimore conduit systems, gave the following estimates to the deputation of the Manchester Corporation, and though the figures apply to American construction, they are useful as comparisons:—

Slot conduit system, one mile of double track, with block paving	£17,221	9	0
Overhead lines, one mile of double track, with block paving	£8,926	3	0

We could give instance upon instance to show that the conduit may be expected to cost about twice as much as the overhead wire, yet in face of established facts we find County Councillors telling the public that the conduit costs very little more than the trolley, and this difference is "compensated for by the economy in working expenses." When Mr. J. Allen Baker contends that "most of the objections raised to the conduit system have arisen from personal interest or from misapprehension caused by *imperfect knowledge*," there can be only one retort; but when he says that "it is naturally to the interests of manufacturers of electrical appliances to advocate a system where the main expenditure goes on electric plant rather than one where the greater part of the money goes on the permanent roadway," the statements become farcical. We ask Mr. Baker as an engineer if he considers that there is one penny worth more of electrical plant in an overhead wire than in a conduit system? The electrical manufacturer benefits just as much under one system as the other. But what should be of more concern to Mr. Baker is the unnecessary expenditure of public money, and instead of endeavouring to argue with electrical engineers, he should save his eloquence for that section of the public which he represents in the County Council.

Electrical Engineers at the Front.—We have had the pleasure of reading some very graphic and interesting letters written by Company-Serjeant-Major Rorke, A.I.E.E., to his relations at home, from South Africa. From one of these, dated June 18th and 21st, we note that the Electrical Engineers have been assisting in the work of repairing broken bridges at night by rigging up arc lamps. The conditions of this work may be judged from the following extract:—"The range of temperature is so great from noon to midnight, that first one envies the half-naked Kaffir, but when the sun has gone and the night advanced, one cannot slake thirst from the ice in the water bottle." However, it is consoling to know that "when one is days, weeks, months in that open air, sleeping out on the veldt soon becomes no very great trial." It appears that the headquarters of the Electrical Engineers are at Pretoria, from which, as a base, they make excursions to the places where their assistance is required. An interesting tale is that of a party of men who were delayed three days at Roodvaal, during which time they were constantly expecting an attack, but were disappointed, though 40 minutes after their train had left the station *was* attacked and shelled for six hours. Another detachment was working at Leeuw Spruit, repairing a bridge for the third time, when the Boers made a surprise attack, and seven men who were separated from the rest were captured. The others took cover on the usual kopje, and held the enemy at bay until reinforcements arrived at daybreak.

It is pleasing to read of the troops themselves, who had been in many engagements, that they were not changed in the least from the "cheerful, careless, brave men" described by tradition. May their labours soon be crowned with complete success!

D

THE ELECTRIC GENERATING SYSTEM OF PRAGUE.

By FRED. BATHURST, A.M.I.E.E.

Prague, the capital of Bohemia, the third city in magnitude in Austria, has a population of 500,000, and is therefore comparable with English cities such as Birmingham, Liverpool, Manchester, or Leeds. Its new electric generating station, which has now been in operation for about six months, is probably the first three-phase high pressure alternating works on a large scale which undertakes to supply simultaneously, and from a single set of bus bars, the electrical energy required for running the electric tramways, providing an electric motor service, and the public and private lighting of the town.

This plant, it is thought, marks an important step towards the final development of the problem of providing an effective and efficient system of electric distribution for large cities, and as it has thus far given in every respect the results anticipated from it, and further contains several features of novelty, a somewhat detailed description of its mechanical and electrical features may be of interest to the wide circle of the electrical fraternity reached by the Electrical Review.

In 1894 the city authorities of Prague had to consider the question of extending the concession for the horse tramway system then in the hands of a Belgian limited company. This question naturally led to a general discussion, and to the consideration of electric service in connection with street railways, and it was decided that the City Council should undertake the experiment of itself equipping electrically a new route, with a view to obtaining practical information at first hand.

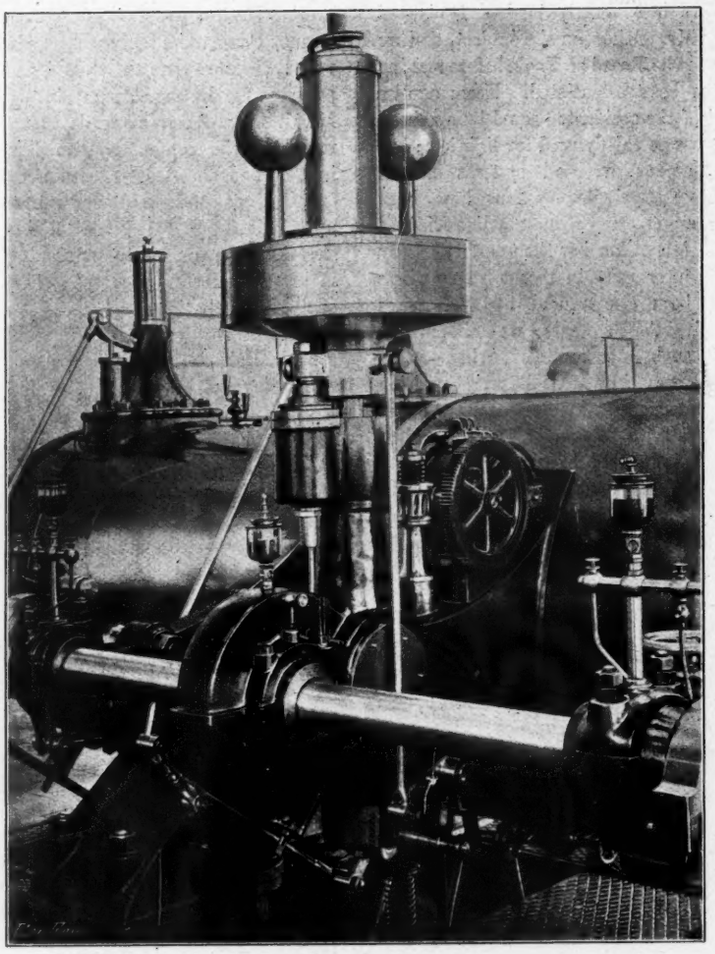

Fig. 1.

At the same time the question of the public and private electric lighting was becoming an increasingly pressing one, so that the chief engineer of the city gas works (Herr Pelikau) was instructed to study the whole question of laying out an electric station from which power could be furnished to meet the demand for electric service in both fields.

This engineer submitted four alternative methods, but recommended, as the best solution, the erection of a large central station in the heart of the city, which should supply continuous currents and feed a number of accumulator substations in different sections of the town.

A number of prominent engineers created a strong opposition to this scheme, and suggested that the true solution lay in the erection of a single large station having uniform supply, which should be placed on the outskirts of the city. In 1896 the various suggestions had matured so far that the town had bought up the horse tramway concession, and decided to extend the street railway system on a large scale and adopt an electrical service.

The programme contemplated was—

1. The erection of a large main generating station in the seventh district (Holeshovic), which should supply high pressure three-phase current.

2. The transformation of this current at certain substations from three-phase high pressure into 600 volts continuous current.

3. The direct distribution of three-phase current for light and power to private consumers from closed secondary networks supplied from fixed groups of transformers.

4. The distribution of current for public street lighting from suitable 600-volt continuous current mains.

Offers to carry out these plans were received from seven firms, and that submitted by the firm of Kolben & Co. was accepted, and work started in 1898.* For convenience of description, the whole plant may be divided into three parts:—(1) The generating station proper. (2) The secondary or sub-distributing stations. (3) The cable network.

The generating station shown in fig. 2 is located in the Holeshovic district, between the river and the State railway, so as to obtain convenient supply of coal and water. In addition to the engine and boiler house, a coal storage, a general store, and an office building, also the car barn and car repair shop, are situated here. When completed, the engine room will have the approximate dimensions—length 460 feet, width 70 feet, height 36 feet; but at present it has been necessary to complete a length of 300 feet only.

In order to improve its lighting, the central portion of the engine room is built out as an ornamental extension, some 65 feet in height, and arranged in two floors. In this portion the main switchboard is arranged, and around it the various laboratory testing and staff rooms.

The boiler house (fig. 3) is arranged alongside the engine room, being equal to it in length, and having a width of about 60 feet, and a height of about 25 feet; the condensing and feed-water pumping apparatus is arranged near the engines, whilst the main feed-water tank and filtering apparatus are placed contiguous to the boiler house. Capacity is provided for an ultimate total of 32 boilers (Tichbien's system), but at present only 16 are required. Each boiler has a heating surface of 2,500 square feet, and consists of two flame tubes arranged under an upper tubular boiler. Separate steam superheaters (Schwœrers) of about 1,000 square feet superheating surface are provided, so that the steam coming from the boilers at 170 lbs. per

*The Kolben works were described by the writer in the Electrical Review, August 18th and 25th, 1899.

square inch pressure can be superheated up to 600° F. The boilers are divided up into batteries, four constituting a set, and separate flues are arranged for every two sets, so that ultimately the boiler house will have four distinct chimney stacks towering to a height of 280 feet, and 3 feet in diameter at the top. The main steam piping is arranged in ring form directly above the boilers, connections being made to it so that any engine can be worked either by steam

Fig. 2.—Engine Room, showing Novel Arrangement of Exciter.

coming direct from the boiler, or by steam which has passed the superheater, so that the engines can work with or without condensation. The condensation is effected by water brought direct from the river by a duct of oval cross-section (about 42 inches × 37 inches), which is arranged underneath the engine room in its whole length. A special suction well is provided under each engine, its opening from the river being fitted with suitable valves to guard against the possibility of extra high water. A second duct of larger cross-section carries away the warm water (after it leaves the condensers), and passes it towards the pumping apparatus, by which it is forced into the filter tanks, and thence used as the boiler feed water. Triplicate pumping apparatus is provided, namely, rotary pumps (Encke system), compound piston pumps, and injectors. The rotary pumps, each driven by a 4 H.P. three-phase motor, pass the water from the duct into the reservoir feeding the filters, whilst the piston pumps pass the water from the filters to the boilers. The injectors are used as a standby. Four sets of Desrumaux filter apparatus of 30 square metre surface, and the requisite reservoir tanks are employed.

Coal is brought by the railway to a cold storage building, by a side track which is higher than its floor level, so that it may be directly discharged into the building. An electric elevating apparatus fills special small tilting cars running on a track arranged through the boiler house, and these unload into the automatic stokers provided for each battery of boilers, and driven by a 4-H.P. motor. The ashes coming from the boilers are emptied into baskets which discharge into similar small tilting cars, which run in a tunnel arranged under the boiler floor, and are passed on to the ash house by means of further electrically-driven elevators.

The engine room is traversed throughout by a travelling crane of 20 tons carrying capacity. In it there are at present located five steam dynamo sets of 1,000 E.H.P. each, although space is provided so that five more sets of 2,000 H.P. can be ultimately put down. Four of the present sets can carry the load now on the station, the fifth set being held as a reserve. The steam engines are of the horizontal triple-expansion type, the high pressure cylinder, 20 inches diameter, with the medium pressure cylinder, 30 inches in diameter, being arranged on one side, whilst the low pressure cylinder, 48 inches diameter, and condenser air-pump are arranged on the other side of the fly-wheel type generator. The length of the stroke is 4 feet. The low pressure cylinder has Corliss type valve gearing, while the high pressure cylinders are controlled by a centrifugal governor, the weight of which can be changed in position by means of a suitable lever combination and spur and wheel gearing (fig. 1), which is driven by a ¼-H.P. three-phase motor, adjusted and controlled from the switchboard gallery. In this way the attendant can adjust the speed of each engine from his stand, and the generators can be switched into parallel without first artificially loading. The most economical working of the engines is 750 H.P. at 90 revolutions per minute. The magnet wheel (rotor) of the generator is placed directly upon the crankshaft of the engine between the high and low pressure cylinder divisions. Arranged concentrically around this wheel is the stator, which carries the high pressure winding, and which is mounted on a cast-iron bedplate in a manner which allows it to be moved in an axial direction.

These three-phase generators have been built by the Electricitäts Actien-Gesellschaft vormals Kolben & Co., of Prague-Vysocan, and are designed for an intake of 1,000 H.P. working on an inductive load with a power factor of 0·85, and give therefore a useful output of 825 KW. at 300 volts pressure, the current in each phase being 160 amperes. The revolving magnet wheel has 64 poles and generates at 90 revolutions per minute, 48 periods per second; it consists of a divided cast-iron fly-wheel carried by 10 double arms springing from the hub. Cast

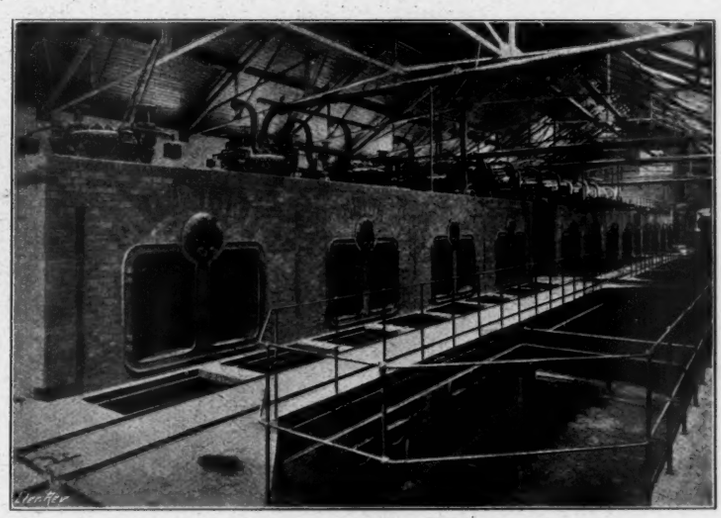

Fig. 3.—Boiler House.

steel magnet cores are secured in the rim. These magnet cores are of oval cross-section at one end and have a cylindrical prolongation at the other end which exactly fits the holes bored in the cast-iron rim. This construction reduces the contact surface between the steel and cast-iron, so as to correspond to the different magnetic reluctances of these materials. The pole-shoes are made of laminated sheet-iron, the steel cores being cast directly into them, it is thus possible without complicated mechanical connections to entirely

prevent the creation of eddy currents in the pole-pieces, and nevertheless provide sufficiently large peripheral surfaces in the stator iron ring in order to lay the armature coils in the necessary slots. The magnet winding is made up of flat copper bands, 1 inch wide wound up on edge, being first pressed

Fig. 1.

together under hydraulic pressure and then pressed upon the cores; the circumferential speed of the magnet wheel is some 80 feet per second, and its diameter is about 17 feet. The stator or stationary armature carries the high pressure winding, and is built up with a laminated iron core ring, the slots being insulated by micanite troughs. The winding consists of 96 coils laid in the slots and solidly fastened therein. This core ring is carried in a strong cast-iron frame ring which, as before stated, can be moved axially so that any single armature coil as well as magnet coil can be easily replaced if necessary. The stator frame is also adjustable in a vertical direction by means of strong adjusting bolts which rest upon cast-iron bedplate. The magnetic proportions of the alternator, as well as its windings, are so calculated that very small pressure variations are noticeable even with varying loads; the design provides high air-gap induction, strong iron saturations, small armature leakage and reactance. The generators have a good pressure characteristic at no load, and a favourable short circuit curve. The full load current is reacted with the short circuited armature windings at an excitation corresponding to one-third of the normal voltage. The machines work at full and even overload very quietly and without humming noise. The total weight of the generating machine, excluding exciter, is 140,000 lbs. The exciter is driven from the engine main shaft by means of a helical gearing with a reduction of 1:4. The worm wheel is made in two pieces of phosphor bronze, and is keyed directly on to the shaft and drives on to a worm shaft of hardened steel. This shaft runs in ball-thrust bearings, and the whole gearing is enclosed in a tightly fitting grease case. The shaft is provided with a rigid coupling which connects to a continuous current exciter dynamo, having an output of 10 kw., and this method of conveniently driving an exciter from a double crank horizontal engine (see fig. 2) solves a difficult problem in a very successful and neat manner.

(To be continued.)

THE BOIS DE BOULOGNE COMBINED TROLLEY AND SURFACE CONTACT TRAMWAY.*

M. Vedovelli's system of electric traction with surface contacts has just been applied to the Bois de Boulogne railway which extends from the Neuilly Gate to Saint Cloud, passing along the Bois de Boulogne, passing in succession through the Sablous Gate and the Madrid Gate, following the Seine for about 1,500 metres and crossing it at the Suresnes Bridge and arriving at the terminus at the summit of the Val d'Or. The traction is of a mixed character, the line being divided into nine sections worked alternately by the trolley system and by surface contacts. The contact system was ordered by the administration to be used at the gates and at all points where it was considered that the overhead line would detract from the beauty of the scenery of which Paris has every reason to be proud. Fig. 1 shows a view of the station at the Neuilly Gate; at the starting point the overhead wire is used.

Near the Hippodrome at Longchamps, before arriving at the Suresnes Bridge, a loop line (fig. 2) has been made in order to allow of a special service between the Suresnes Bridge and the Neuilly Gate.

It was necessary to arrange, for this service, for those days when, owing to attractions of the Hippodrome, the traffic will be considerably increased. It was really the importance

Fig. 2.

* Paper read by M. X. Gosselin before the Société Internationale des Electriciens. Translated from the Journal of the Society. We are indebted to the publishers for the illustrations.—Eds. Elec. Rev.

of this traffic that decided the employment of the contact system and caused it to be chosen in preference to the other, without taking into account considerations of economy.

The line being divided into various sections, it was desired to avoid the stoppages and jerks that might occur in passing from one system to the other. With the contact system the change in the mode of working is effected at the normal speed. To do this the trolley line is continued for some metres over the contact line, so that for a few seconds the car is receiving the energy both through the wire and through the contact blocks. Moreover, in order to facilitate the resumption of the wire, a bow is used which is brought to rest automatically on the line at the moment it comes into action. Fig. 3 is another view of the surface contact line.

Fig. 3.

The Bridge of Suresnes is traversed by a single line worked by contacts. Fig. 4 shows a view of the overhead line along the Boulevard de Versailles. Fig. 5 is a photograph of the generator room. The plant was supplied by the Fives-Lille Company. It consists of two groups of generators, one of 400 KW. power, the other, which acts as a reserve, of 250 KW.

The steam engines are of the well-known horizontal Fives-Lille type with four distributors. The dynamos are over-compound 500-volt machines.

Two feeders start from the board, one supplying the up line, and the other the down line, and are branched into the section comprised between Longchamps and the Neuilly Gate.

This board is furnished with the ordinary measuring and safety apparatus, voltmeter, amperemeter, lightning conductor, and automatic circuit breakers.

The rolling stock consists of motor cars and trailers, fig. 6. The cars measure 9·40 metres between the buffers, and are mounted on two pairs of wheels. The distance between the axles is 4·80 metres. The curves of the track have at several points a very short radius (25 metres), and in order to round them the axles have had to be mounted on converging jointed trucks, which act very satisfactorily.

Fig. 7 shows a diagram of M. Vedovelli's system of line with surface contacts.

L is the line conveying the current, P_1, P_2, P_3, the contact studs over which the contact bar, B B^1, of the tramway passes in succession, and receives the current, which passes on to the electric motors, returning to the station by the rail.

The tramcar goes in the direction of the arrow, F.

Referring to the contact bar at the moment it receives, normally, current from the stud P_1, as soon as the extremity, B, of the bar touches the stud, P_2, a derived current passes through a solenoid, S_2, of fine wire, and returns to earth, *i.e.*, to the rail, by the two terminals, a_2 and b_2, connected on short circuit by a bridge-piece, K_2, which is movable round an axis of rotation, O_2. The solenoid contains an armature of soft iron connected with the supporting lever of the bridge-piece, K_2, so that when the solenoid receives the current and attracts its armature, the bridge-piece, K_2, is raised vertically. It leaves the terminals, a_2 and b_2, on which it rested freely, and bears heavily on the terminals, c_2 and d_2, which it short circuits. Now the terminal, d_2, receives the current directly from the line, the stud, P_2, comes, therefore, into metallic connection with the main line, L. The stud, P_1, remains capable of feeding the contact bar of the tramway until the next stud, P_2, has in its turn been brought into metallic connection with the line, L. Now when the bar, still travelling in the direction of the arrow, F, has passed into the position shown by the dotted lines in the figure, the solenoid, S_2, following the mechanism explained above, will have attracted its armature, and the bridge-piece, K_2, having connected the terminals, c_2 d_2, will, on the contrary, have cut the circuit between the terminals, a_2 and b_2. The derived current pass-

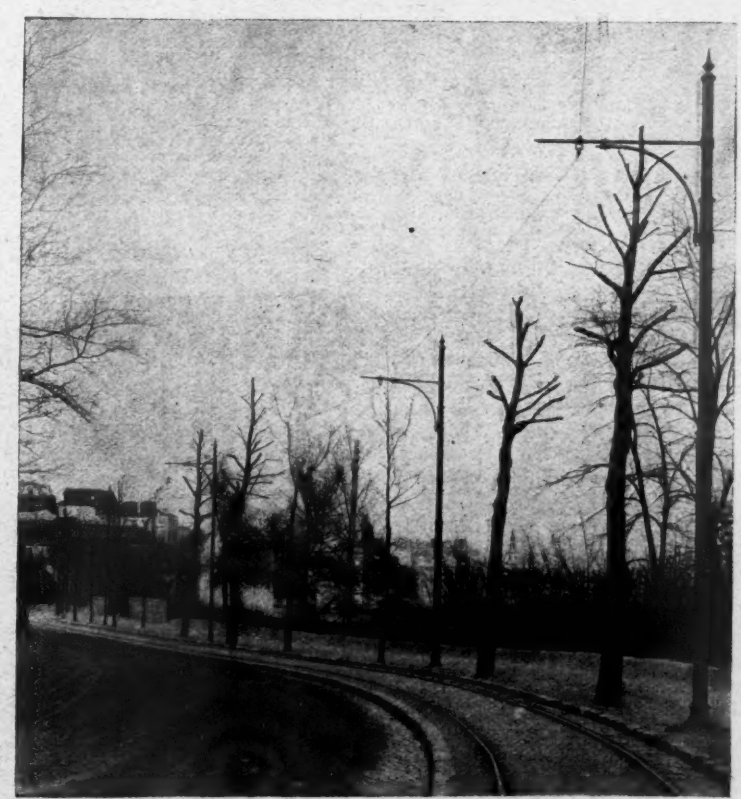

Fig. 4.

ing through the solenoid, S_2, is therefore interrupted at these points. The armature, K_2, falls back upon the terminals, a_2 b_2, and the terminals, c_2 d_2, are disconnected. The stud, P_2, is thus also disconnected.

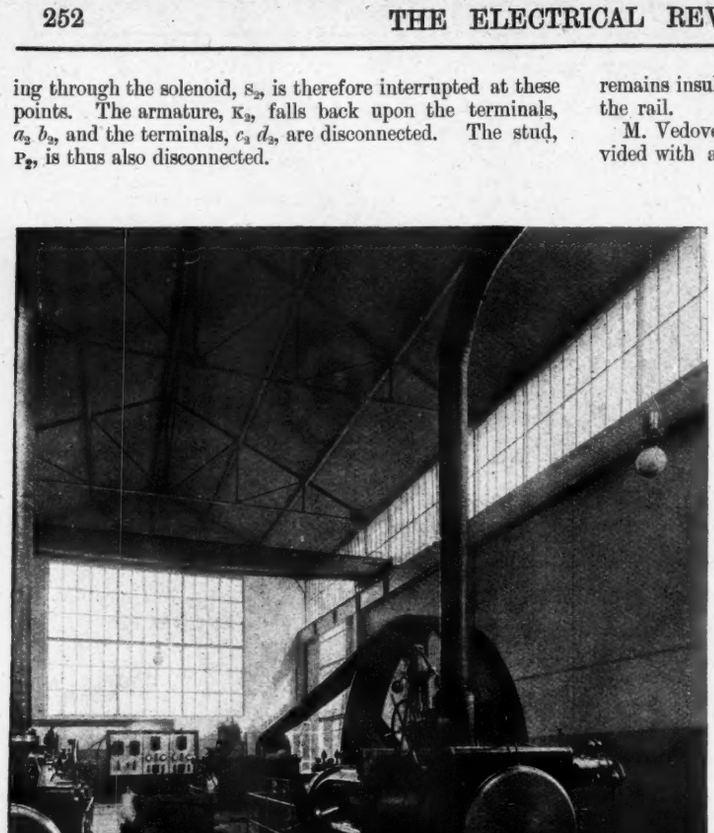

Fig. 5.

Thus by a very simple arrangement the introduction into the circuit of one stud shuts the preceding stud out of the circuit.

By virtue of a very ingenious device, the bridge piece, K, only leaves the terminals, *a b*, after having connected the terminals, *c d*. It follows from this arrangement:—(1) That the main current is brought to the stud required by the contact bar, and that the closing of the studs, *c d*, does not serve to establish the main current; (2) that the terminals, *c d*, are disconnected when the stud about to be released is still in contact with the bar. These terminals, therefore, do not serve to break the current, which is always done in the contact bar.

It is, in fact, of the highest importance for the good working and the durability of the apparatus that the terminals, *c*, *d*, should be used, not as interrupters, which would be the seat of sparks and so be rendered liable to rapid burning up, but as commutators connecting or separating metallic terminals, brought to the same potential, no spark between them being then possible.

We have supposed the tramway to be working normally. At the commencement the first stud will evidently receive the current either from the trolley or from a stud charged by hand as the cars start from the works. The last stud of a section consists simply of a commutator of the ordinary type, of which the terminal, *d*, remains insulated and the solenoid is directly connected with the rail.

M. Vedovelli's tramway, like all others of the kind, is provided with a safety apparatus, in order to prevent a stud from being uncovered by the vehicle while it is still charged. This arrangement consists in this case of a pendant chain connected permanently with the earth and brushing in succession the studs released by the car. If by accident one of these studs remained charged, the chain by its contact would produce a short circuit on the line, and would bring about either the melting of the safety fuses placed in the corresponding distributor, or the release of the automatic circuit-breaker of the central station.

M. Vedovelli's system, by the very fact that the stud when charged effects by its introduction into the circuit the release of the preceding stud, gives the vehicle a well defined rate of proceeding. The mechanism which we have described for the successive excitation and release of the studs is not reversible.

In cases where the requirements of the road necessitate the establishment of a single line, and where consequently we are obliged to have vehicles travelling in both directions on the same line, a simple solution of the problem is to supply the track with a double series of distributors; some feeding the up line and some the down line.

In this case, in order to prevent the studs of the up line from being charged by the up cars, the extremities of the solenoids may be connected with a common earth wire which will be insulated from or brought into contact with the rail as required, by a single commutator worked automatically by the vehicle itself.

We may also remark that in order to reverse the action of the distributors, we have only to switch the connections to earth of the solenoids which are to be connected with the right hand commutator in the case where the direction in which the car is proceeding is the opposite one to that indicated by the arrow. This reversal of the connections may be effected by means of a simple two-way commutator placed in the distributor.

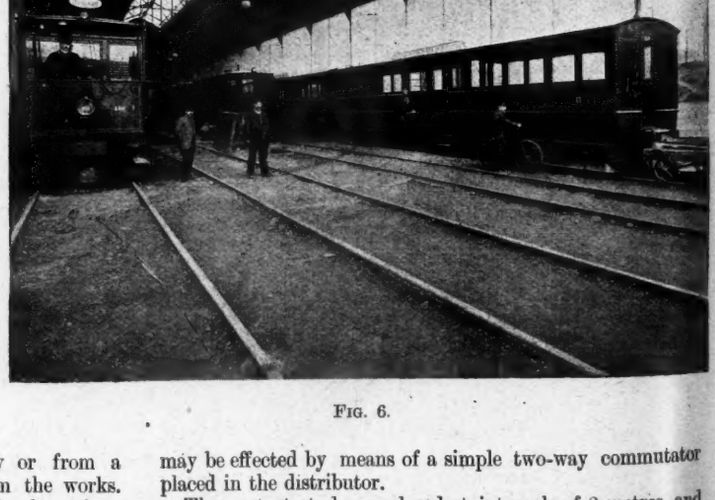

Fig. 6.

The contact studs are placed at intervals of 3 metres, and the distributors 10 in number are placed in leaden boxes

along the side of the track. A single commutator then controls the whole of the corresponding section, and can be manipulated automatically by the passing of the train.

This subjection of the direction of the car to that of the action of the distributors occurs inevitably in all tramway systems worked by contacts in which the stud charged cuts off the current from the disconnected stud.

In certain instances this inconvenience becomes a real advantage, as the electric system of feeding constitutes in itself an inviolable automatic block system.

It will be noticed that the tram when in motion never covers more than two studs. The track therefore becomes free as soon as the vehicle has passed, and a second car can follow at an interval of a few metres.

This is an advantage over some systems in which the line has to be divided into sections which one car, and only one, must occupy at a time, or a stoppage will be occasioned in the normal distribution of the current.

One of the contingencies to be provided against in the stud system of tramways is the failure of the bar to make contact with a stud either through the bad working of one of the distributors or through the accidental interposition of some insulating material, a piece of wood, sheet of paper, &c.

In the system we are describing, if the car fails to make contact with a stud, the preceding one is not disconnected, and the safety chains on touching it, produce a short circuit which brings into action the fusible safety apparatus or automatic circuit-breakers.

The current is thus broken on the disconnected stud. By hypothesis, it is not established on the next: the car stops.

It is, in my opinion, one of the great advantages of the system never to allow the car to pass a stud that has not worked normally.

We can thus be absolutely sure that in the course of the working any defect produced will reveal itself at once, so that the remedy can be applied immediately. All tramway systems worked by contacts do not offer this security.

The utilisation of the distributors as commutators and not as interrupters ensures, as we have already remarked, the suppression of arcs of establishment or breakage of current in the apparatus.

The result is great reliability of working as regards derivations of currents which might be produced on the line between the studs and the earth when the insulation of the contacts is defective. We passed a car over some studs on which we had purposely established an artificial derivation, allowing about 80 amperes over the normal charge to pass. As the breakages of the arc took place on the contact bar, the distributing apparatus supported the overload very well.

In short, therefore, M. Vedovelli's tramway seems very interesting from the point of view of simplicity of mechanism and safety of working.

BRADFORD CORPORATION TRAMWAY CONTRACTS.

In our last issue we published and commented on a letter addressed to the Bradford Town Council on the subject of the contracts for the electrical overhead equipment of the new tramways. In reply to this, a long rejoinder, embodying also the above letter, has been addressed to the Town Council by the contractors who are carrying out the work. In order to save space, we have taken the liberty of omitting the extracts from the first letter, where indicated by asterisks, which may be referred to in our previous number, and we have also omitted certain passages which contain injurious reflections upon the writers of it :—

August 7th, 1900.

To the Tramway Committee of the City of Bradford, Town Hall, Bradford.

Gentlemen,—Our attention has been called to a letter published and sent to your Corporation on or about the 2nd inst., by R. W. Blackwell & Co., Limited, of London. We are amazed at its contents, as the letter is an indictment of your honourable body and your engineers, and a most serious reflection on our integrity and ability as contracting engineers. We, therefore, have taken the right to answer every paragraph of this letter. You will note in our letter that we have quoted R. W. Blackwell & Co.'s paragraphs and our answers to them—in some cases our answers are in the form of questions.

* * * * *

Answer 1.—Did any of Blackwell's engineers, agents, or men see

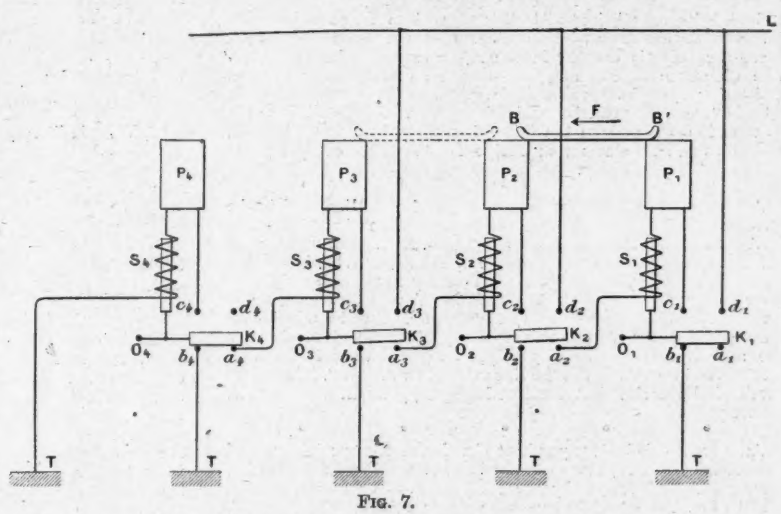

FIG. 7.

or make any suggestions regarding the specifications before they were submitted for tendering?

* * * * *

Answer 2.—Did R. W. Blackwell & Co., Limited, tender in direct accordance with your specifications when they were endeavouring to force in a revised tender after the tenders had been opened and before they had been submitted for acceptance by your Tramway Committee?

* * * * *

Answer 3.—Macartney, McElroy & Co., Limited, did tender in accordance with the specifications, and there has not been any material departure from the specifications, and what slight changes have been made are beneficial, such as are usual in contract work, which the Corporation of Bradford or other cities have a perfect right to make, as stated in the common conditions of all specifications, without consulting R. W. Blackwell & Co., Limited.

* * * * *

Answer 4.—Were not the samples on exhibition at the city surveyor's office samples furnished by R. W. Blackwell & Co., and such samples being material of which he claims to have the exclusive right of sale, and what no other contractors but themselves could furnish to Bradford without their permission? Did not the specifications state that the material need only be equal to them? There are several manufacturers turning out material of same type equal if not better than material furnished by Blackwell & Co., Limited.

* * * * *

Answer 5.—Have not tests and analysis proved that the so-called Ætna and Hecla insulation are of practically the same composition, but of a different colour? The manufacturers' list shows that there is less than 1d. difference in the shilling between the two when assembled with the usual fittings. The competing trade in America know the reason for the difference.

* * * * *

Answer 6.—What is the breaking strain of a $\frac{3}{8}$ inch bolt? It is 10,908 lbs.—What is the maximum weight of 40 yards (one span) of three-nought trolley wire, such as you are using? It is 65·6 lbs.—What is the cross-section of the Dirigo steel stud referred to by Blackwell? It is $\frac{3}{4}$ inch, plus $\frac{1}{100}$th of an inch.—What is the cross-section of the Anderson so-called $\frac{3}{4}$ inch steel stud referred to by Blackwell? It is $\frac{3}{4}$ inch, less $\frac{1}{100}$th of an inch. Therefore, the "Dirigo" bolt, which is being used on your line, is larger in cross-section by $\frac{2}{100}$th of a inch, and technically must be the stronger.—What is the weight of the insulating compound on the "Dirigo" bolt? It is $2\frac{3}{4}$ ozs. This is the bolt referred to by Blackwell.—What is the weight of the insulating compound on the Anderson $\frac{3}{4}$ inch bolt? It is $2\frac{1}{4}$ ozs.—What is the length of the Dirigo bolt (stripped)? $3\frac{3}{8}$ inches.—What is the length of the Anderson bolt? $3\frac{7}{8}$ inches. Therefore, technically, there is more insulation, which is the costliest part of the complete bolt, on the "Dirigo" bolt than there is on the Anderson bolt, as the Anderson bolt is $\frac{1}{2}$ inch longer than the Dirigo bolt, which is not necessary. There is also more

insulation to the cross-section of the Dirigo bolt than there is to the cross-section of the Anderson bolt. This is a decided advantage. These true facts prove that Blackwell's statement that the insulation is about 30 per cent. heavier, is not correct. Blackwell & Co. state that Dirigo insulation has not been tested. Every piece is tested before leaving the factory, and the same insulation has been under a practical test on the Dover lines three years, Glasgow lines two years, Halifax two years, West Hartlepool 18 months, Southampton 12 months, Aberdeen eight months, and hundreds of cities in the United States and Canada and the Continent. Blackwell & Co.'s statement is again incorrect.

* * * * *

Answer 7.—The late Dr. J. Hopkinson no doubt specified the insulators referred to. He did not design it, as it was in actual use in America four years before he became consulting engineer to the Liverpool Tramways. The $\frac{3}{4}$ inch bolt was first used, to the writer's knowledge, for the large figure 8-wire, but was discarded, due to the necessary decrease of insulation on the $\frac{3}{4}$ inch bolt—there being more insulation on the $\frac{5}{8}$ inch bolt for the fittings, which are common to both bolts and all sizes of trolley wire. The Ætna and Dirigo insulation manufacturers' lists show that the complete fitting, including bolts, is cheaper in the Ætna case than in the Dirigo. The difference in cost for your complete contract on this basis, estimating 1,000 hangers would be used, would be approximately £14, in favour of the Dirigo, which is costlier. Blackwell is again in error in stating where the $\frac{3}{4}$-inch insulating bolt was designed, and also when he states that Dirigo insulation is a cheaper grade and designed differently.

* * * * *

Answer 8.—The 2-feet ears are too heavy for the line, and in the writer's opinion, is the cause of so many lines breaking—note Liverpool line came down on July 24th, 1900. Our lines, with three-nought wire, with the 18-inch ear, and stronger, but less bulky, fittings, have never come down. You can have too much weight on your trolley wire in ears and fittings, through an effort being made up for defects in the construction elsewhere, of which some contractors are ignorant. Inspect the Liverpool lines, and see if they are as well and substantially built, wire as tight, and in the same workmanship condition as the lines built by us for you. As far as mechanical and electrical construction goes, you will find there is no comparison.

* * * * *

Answer 9.—We believe you have abandoned the special type of the section insulator, because it has been found in actual practice, on the lines built for you by Blackwell & Co., to be faulty, and an obstruction. You certainly have the right to discard faulty material, even if specified, without consulting R. W. Blackwell & Co. or other contractors. The section insulator we are erecting is equal, if not better, than the samples furnished by Blackwell & Co. to your city surveyor's office for his competitors to tender on. Some of their competitors have had a much longer and more varied experience than they themselves have had, and are competent to design and select line fittings in accordance with the true intent and meaning of your specifications, without placing themselves in a position to purchase from their competitors, R. W. Blackwell & Co., and thereby be absolutely in their power regarding material and delivery.

* * * * *

Answer 10.—The poles, pole trimmings, and fittings being supplied by us are of a much neater design, heavier in every way than those supplied by Blackwell & Co. to you. The bases alone are approximately 1 cwt. heavier, and of a much better design than those furnished by Blackwell & Co. In support of this statement we have a claim for an extra for weight on these bases over that figured on the drawing shown us when making up our tender. Blackwell must again be in error.

* * * * *

Answer 11.—The bracket arm fittings are of a superior design to those furnished by Blackwell & Co., and in their misplaced zeal to criticise and draw objections to work which does not concern them, they have made a statement in the last paragraph which does not appear in your specifications, *i.e.*, "the flexible suspensions were specified to be entirely free from the bracket arm fittings." The design you have accepted is an improvement on the type furnished you by R. W. Blackwell & Co., and the inner base of the flexible arrangement is held more rigid by the strut rod, which not only gives support to the bracket arm, but also supports rigidly the flexible base. This is mechanical engineering, and this design was turned out by a mechanical engineer who specified malleable fittings instead of cast-iron, of which the brackets supplied by Blackwell & Co. to you are made.

* * * * *

Answer 12.—A comparison between the work and material erected by us, and being erected by us, and the work and material erected by R. W. Blackwell & Co. in your city, will prove to even a layman which is the superior work. Blackwell & Co. are in error again. Blackwell & Co.'s so-called estimate of a difference of £851 16s. 10d. is an absurdity. How could they get their estimate down to shillings and pence before our complete contract is finished, and without actually finding out the cost to us of all our material? Their skill in estimating in this case is on a par with the skill shown in the estimate of their tender for your contract, which was £1,476 (approximately) higher than Macartney, M'Elroy & Co.'s when tenders were opened at 10 o'clock in the morning by your sub-committee, and their futile attempt to hand in a revised and lower tender before the tenders were considered by your Tramway Committee at 4 o'clock in the afternoon. This was the crowning error of all, and now their letter plainly shows the hand of a disappointed competitor who will not, and cannot, acknowledge defeat.

The above paragraphs [omitted] have been taken from a letter signed by R. W. Blackwell & Co. which appeared in the *Bradford Observer* of the 3rd inst. Are Blackwell & Co. your engineers, and have they a claim on Bradford? Have they the right to question or object to your exercising the powers which are given you under the clauses in the general conditions of our contract with you? Who and what is this firm that practically would dictate to your city and your city officials as to what you should do? . . . . . We tender fair on specifications which we never see until they are submitted to us for tendering purposes. We never endeavour to have material which we claim to have an exclusive right over, specified, nor do we furnish samples of the same material so that we may have an advantage over legitimate competitors. Neither do we request the permission to revise our tender . . . . . after all other tenders have been opened, but not acted upon.

We are amazed at the public liberty this firm has taken in criticising your actions. . . . . Our work speaks, and will speak, for itself. Compare it in all its details with the work and material erected by R. W. Blackwell & Co. in your city. Test the work and material of both contractors, in actual use, and by the mile or tens of miles. The comparison will favour us, and show the weakness of the position which this firm has taken up.

We remain, yours respectfully,

(Signed) Macartney, McElroy & Co., Limited,
J. F. Macartney, *Managing Director.*
Contractors to the Bradford Corporation.

53, Victoria Street, Westminster, London, S.W.

A meeting of the Tramways Committee of the City Council was held on the 9th inst., the chairman (Alderman J. Cowgill) presiding. The letters concerning the tramway contracts had previously been referred to a sub-committee, and the following report upon their conclusions in the matter was presented :—

The sub-committee having considered the matters referred to them, beg to report as follows:—They have received very full explanations from the chairman, the city surveyor, and the contractors, Messrs. Macartney, McElroy & Co., with reference to the statements contained in Messrs. Blackwell & Co.'s letter, and the circumstances in connection with the acceptance of Messrs. Macartney, McElroy & Co.'s tender, and the subsequent carrying out of the works to date. They find that originally five tenders were delivered, including Messrs. Blackwell's and Messrs. Macartney's tenders, that the tenders were all, according to the then custom, opened by the chairman and Mr. Dawson (as representing the city surveyor), and not by a sub-committee, as stated in Messrs. Macartney's letter, after which they were initialled, with a view to their tabulation and analysis, for consideration at the meeting of the Tramways Committee the same afternoon. It appears that subsequent to the opening of the tenders Messrs. Blackwell's representative saw the chairman, and was informed by him that their firm "was considerably out of it." Messrs. Blackwell's representative delivered to the chairman an amended tender, offering to do the work at an amount less than was previously tendered by them, and below that of Messrs. Macartney, but he informed them that he doubted whether the Committee would consider it. This amended tender was submitted with the other tenders, but was not accepted. It appears that Messrs. Blackwell's amended tender having been addressed to the chairman, was returned by him to Messrs. Blackwell. Messrs. Macartney executed their contract in due course, and have commenced the execution of the works. Certain variations in the contract have been made since the tender was accepted, with the full knowledge and approval of the Committee and their engineers. The contract provides for variations, alterations, omissions, and deductions, as all contracts do, and Messrs. Macartney are carrying out their contract subject thereto in accordance with the specification, and the Committee are quite satisfied that in every case the substituted apparatus and materials are at least fully equal to those already specified, and in many cases an improvement.

The report was adopted by the Tramways Committee, and it was subsequently approved at a meeting of the Finance and General Purposes Committee.

The following letter was subsequently received by the Corporation :—

To his Worship the Mayor and Council of the City of Bradford.

Dear Sirs,—Our attention has been drawn to the statement concerning our letter to you of July 31st, which was made by Messrs. Macartney, McElroy & Co., Limited, to the Special Sub-committee of the Tramways Committee. This in no way denies the accuracy of our statement, that the goods which are now being supplied are not in accordance with the specification, or that they are lighter and cheaper than those which you called for, and they agree to supply.

We respectfully submit our criticisms on the statement abovementioned.

1. We supplied a certain amount of information to the city engineers at their request. This was an act of courtesy on our part. Your engineers and the Tramways Committee are fully qualified, in our opinion, to decide what shall or shall not, appear in your specifications.

2. Our tender was in strict accordance with your specification, and we would have carried out the work strictly in accordance therewith.

3. The departures from your specification are not immaterial or slight, and the changes made are not beneficial. In every case cheaper material has been supplied than that which was called for.

4. The samples shown at the city surveyor's office were purchased by the city of Bradford. The Tramways Committee and the city engineers had picked this type out as being most suitable for their requirements.

This material can be supplied by any contractor.

Messrs. Macartney, McElroy & Co. themselves have quite recently proposed to supply insulators of this manufacture to the Corporation of Manchester.

5. We append an extract from a letter from Messrs. Albert and J. M. Anderson, the manufacturers of "Ætna" and "Hecla" insulating material:—

"The 'Ætna' compound, as made to-day, is made of the same materials, and by the same process, as that first made. The 'Hecla' material was gotten out for competition with other and cheaper materials. Some of the ingredients of the 'Hecla' material being cheaper, we were able to make it at a lower cost than 'Ætna.'"

6. It is British practice to use ¾-inch bolts with 3-0 trolley wire. All experienced English engineers are agreed on this point. It is the threaded portion of the bolt which requires strengthening. It is not the weight of the trolley wire, but the vibration of it and possible shocks due to coming off of the trolley head which have to be considered. Permanency and rigidity has always been the feature of British construction.

It is an easy matter to ascertain what the difference of weight is between the complete insulators which were on view at the city surveyor's office, and which were specified by you, and those which are now being supplied.

7. The late Dr. John Hopkinson, F.R.S., &c., did design as well as specify, the insulators referred to. The "Ætna" insulators, with ¾-inch bolts, were made to Dr. John Hopkinson's design and specification.

The following is an extract from a letter received from Messrs. Anderson in 1897:—

"We are in receipt of your favour with regard to sample ¾-inch bolts, designed for Liverpool. As it involves expense to make both forging dies and moulding dies, we do not wish to make up those tools of the wrong size. We presume that you have decided on having the ¾-inch bolt, but it may be that we are wrong. As it seems a matter of importance, it will be best for you to cable us which size of bolt you wish to use."

As regards the question of cost, price lists are no avail, unless discounts are appended, which, as is well known, varies in the case of every manufacturer of the same article.

From actual figures at which we have been purchasing the two types of insulators, viz., "Dirigo," as now being supplied to Bradford, and the "Ætna," as shown in the city surveyor's office, and for which we tendered, amounts to 3¾d. in the shilling; in other words, the insulators called for in the specification cost practically 50 per cent. more than those which are now being put in.

The fittings for the "Ætna" ¾-inch bolts, shown at the city surveyor's office, and the "Dirigo" ¾-inch bolts, are not common to both. The fittings for the "Ætna" ¾-inch bolt are larger and heavier.

8. The ears carry the trolley wire, and not the trolley wire the ears. This is quite evident. Therefore the longer the ears, the better the trolley wire is supported. Lines with shorter ears have frequently come down, as at Aberdeen and Southport.

We should be very pleased for the Bradford Corporation to inspect the work done by us in Liverpool. This is the largest system now being operated in Great Britain, and we should be very glad for them to procure from the officials connected with that line any information on the same which they may want.

9. The section insulators in question were designed by the engineers of the Corporation, and were called for in the specification.

10. It is obvious that the original bases and fittings supplied on your first and earlier lines have been confused with those which you called for in connection with your extensions in your specification of 1900. These fittings and bases were of a totally different design. This can easily be verified by comparing the drawings, which were shown at the city surveyor's office, with the fittings previously supplied. The actual weight of the bases which we proposed to supply, and which we are now actually manufacturing for other work we have in hand, was:—3 cwt. 1 qr. for the No. 1 pole, 3 cwt. 2 qrs. for No. 2 pole, and 3 cwt. 3 qrs. 30 lbs. for the No. 3 pole.

If you will weigh the bases which are now being supplied, and compare them with these figures, you will see that ours were much heavier. The same thing holds good with the fittings.

It seems to us that instead of giving extra price for these bases, you should have an allowance made.

11. The drawings accompanying the specification of 1900 distinctly showed that the flexible suspension brackets had to be entirely free from the bracket arm fittings. The design called for in your specification was naturally of a totally different character to that which we supplied on your original contract. The specification of 1900 called for a different article, and this should, therefore, not be compared with those which we supplied to your previous contract.

We never have, nor do we intend to, cast reflections on the work of our competitors.

We beg respectfully to submit the above statements, and trust that you will favour them with your careful consideration.—We are, dear sirs, yours faithfully,

Robert Blackwell & Co., Limited.
(Signed) B. H. Howell, *Managing Director.*

A letter will also be found in our "Correspondence" columns, bearing upon this subject.

So far as the departures from the specification without corresponding changes in price are concerned, we see no reason for modifying our views already expressed in this matter.

THE ELECTRICAL VOLUNTEERS IN SOUTH AFRICA.

By the courtesy of Major Erskine we are enabled to publish the following:—

13, Victoria Street, Westminster, S.W.

The following is an extract from a report received from Major Crompton, dated Pretoria, July 17th and 18th, 1900, showing where the officers, non-commissioned officers and men of the corps were at work on those dates:—

"Of the six who were taken prisoners two escaped and the other four were released. Lieut. Pott is reported to be convalescent and to be returning home; 2nd Lieut. Bigge, who was wounded, has returned to duty. Of those in hospital, Sapper Dalton is reported to be doing well; Sapper Arundel is convalescent, and owes his life to splendid nursing; Sapper Brander is convalescent. No information is given as to the condition of the others reported in hospital.

"The men have been at work:—

"1. As electric engineers fitting up and repairing electric light and power plant.

"2. Searchlight men.

"3. Arc light men for working parties.

"4. On telephone light lines.

"5. As army telegraphists.

"6. As railway telegraphists.

"7. As Royal Engineers working parties on crib and tressel reconstruction railway bridges.

"8. As a fighting unit."

Major Crompton reports that they have done well in each branch.

Major Crompton has requested me to remember him to all the officers and the corps as a whole, and hopes that what has been done out in Africa will help the corps both as regards its prestige and future popularity, and he feels proud to have had command of such a thorough good lot of men.

(Signed) R. S. Erskine, Major.
Officer Commanding Electrical Engineers, R.E. (Vols.).

No.	Rank and Name.	Remarks.
	Major R. E. B. Crompton	Headquarters, Pretoria.
	Captain F. L. Lloyd	Headquarters, Pretoria.
	" A. Bain	Railway Telegraph, Elandsfontein.
	" H. M. Leaf	Headquarters, Pretoria.
	Lieut. J. F. O'Shaughnessy	Railway Telegraph, Elandsfontein.
	" A. H. Pott	Enteric, Viljoensdrift.
	2nd Lieut. J. H. Stubbs	Army Telegraph, Kroonstadt.
	" A. H. Bigge	Wounded Hospital, Johannesburg.
	" F. Powell Williams	Headquarters, Pretoria.
1672	Sergt.-Major G. A. Brown	" "
6263	C.S.-M. E. Rorke	" "
21109	Sergt. C. T. Ruse	" "
6166	" J. H. S. Phillips	" "
6171	" W. S. Entwistle	Railway Telegraph, Elandsfontein.
6193	" J. H. Brown	Headquarters, Pretoria.
6178	Corpl. H. Bicker-Coaster	In charge Det., Bloemfontein.
6192	" A. H. Graham	Headquarters, Pretoria.
6191	" A. Charlton	Prisoner, believed sent back.
6179	" W. Dalton	Enteric, Kroonstadt.
6206	2nd. Corpl. J. H. Stone	Railway Telegraph, Elandsfontein, reported hospital.
6264	" E. M. Sellon	Released.
6188	Sapper H. R. Allen	Headquarters, Pretoria.
6171	" F. D. Arundel	Enteric, Bloemfontein.
6199	" H. Bertram	Bloemfontein.
6169	" S. M. Bourey	Headquarters, Pretoria.
6196	" R. H. Brander	Sick (Dys.), Bloemfontein.
6210	" G. Charlton	Escaped.
6194	" D. F. Colson	Released.
6180	" W. C. Cooke	Sick, on orderly duty to Lieut. Pott, Viljoens drift.
6187	" M. N. Crawford	Bloemfontein.
6267	" H. F. Claxton	Headquarters, Pretoria.
6269	" W. G. Carter	" "
6197	" A. S. C. Devonshire	" "
6177	" E. J. H. Elliott	" "
6170	" Hodgson, A. J.	Army Telegraph, Kroonstadt.
6203	" Holliday, R. W.	Railway Telegraph, Elandsfontein.
6178	" Hossack, W. H.	Headquarters, Pretoria.
6188	" Horsley, E. C.	" "
6184	" Hounsfield, J. H.	Bloemfontein.
6205	" Hume, D. G. W.	Headquarters, Pretoria.
6201	" Landon, C.	Released.
6209	" Levene, A. E.	Headquarters, Pretoria.
6175	" Love, C. T.	" "
6168	" Melsom, S. W.	" "
6268	" Minns, A. E.	Bloemfontein.
6174	" Paris, H. A.	"
6185	" Pearl, A. R.	Released.
6198	" Pirrie, N. W.	Headquarters, Pretoria.
6165	" Phillips, F. J.	Railway Telegraph, Elandsfontein.
6272	" Payne, F. G.	Enteric Bloemfontein.
6.73	" Paine, C. W. S.	Army Telegraph, Kroonstadt.
6183	" Roberts, R. B.	Headquarters, Pretoria.
61-6	" Rook, J.	Railway Telegraph, Elandsfontein.
6195	" Silverthorne, C. E.	Headquarters, Pretoria.
6190	" Stevens, F. C.	Rail. Tel. Instrument shop, Pretoria.
6207	" Thorn, C. R. H.	Railway Telegraph, Elandsfontein.
6208	" Tilley, B. H.	Army Telegraph, Kroonstadt.
6270	" Taylor, J. D.	" " "
6200	" Wallis, F. J.	Headquarters, Pretoria.
6189	" West, E. J.	Camp Cook, Capt. Bains, Rail, Tel, Det., Elandsfontein.
6172	" Wright, E. J.	Railway Telegraph, Elandsfontein.
6266	" Wiltshire, A. O.	Headquarters, Pretoria.
6181	" Young, F. J.	" "

CORRESPONDENCE.

Failure of Underground Cables.

Although the replies which we have received have elicited some useful information, we had hoped that more contractors would have given their experience as to the general reliability of armoured underground cables. We, ourselves, have found this system far more durable than cables drawn into pipes or conduits, and we were anxious to find out whether the single failure which the makers attributed to the presence of chemicals in the earth, was likely to be repeated elsewhere.

If the makers have supplied us by mistake with a cable which was only suitable for ship lighting, this may explain the matter. Our branch office inform us that the order was for vulcanised rubber, 2,000 megohms, lead-covered, and armoured with galvanised iron wire, braided over all and compounded. If this specification is not suitable for underground work, it would probably be a matter of interest to others besides ourselves. As regards the armouring, we naturally prefer steel taping to iron wire in all larger sizes. As the name of a private house near Coventry was given to the makers, they might, we think, have known that we were not lighting a ship. We believe we are right in saying that their representative took the order for underground use.

Drake & Gorham.

August 9th, 1900.

Arc Lamp Litigation.

In reference to the note appearing in your recent issue, *re* the discontinuance of our action against William Jones Davy, we must ask you, in justice to the Jandus Arc Lamp and Electric Company, Limited, and to our many licensees, to state that proceedings in the nature of a test action upon the Jandus patents are now pending, in which we are advised that (as in the recent Johnson & Phillips' action) we shall have a successful issue.

We shall then deal with the smaller infringers as we did with those licensees who, to their own detriment, elected to join hands with Messrs. Johnson & Phillips in disputing our rights under our licenses.

For the **Jandus Arc Lamp and Electric Company, Limited.**
A. A. Gillies, *Secretary.*

August 8th, 1900.

The British Blahnik Arc Light Company, Limited.

Referring to the notice in your issue of the 27th ult., concerning the appointment of myself as receiver and manager of the above company, it appears that, as a result of the paragraph, it is assumed in the trade that the works are closed, and I shall be glad, therefore, if you will insert this letter as a means of bringing to the notice of your readers, that the business is being continued as before, with the exception that the financial difficulties under which the company was suffering have been obviated by my appointment, and all orders can be promptly dealt with.

M. H. Chantrey,
Receiver and Manager.

57, Moorgate Street, E.C.,
August 13th, 1900.

Electric Cranes.

In reply to the letter in this week's issue, I may say that I have had sole charge of five for nearly three years, and the articles I find best are as follows :—

(*a*) In the 3 and 6-ton cranes I use common soda. In the 10-ton and higher powers I use caustic soda, diluted with water, to suit H.P. of motor.

(*b*) The best insulator to use is porcelain, as the soda has a tendency to creep and soften any other kind of insulation.

(*c*) I use a slide with a loose sleeve of brass so that sleeve can be renewed when worn ; the weight of wire on sleeve makes a good contact, and it can be used on travellers of any power.

Three separate tanks are necessary, and we have not had any trouble from splashing, because the attendant has only to fill them to a certain height. If you had a triple rheostat, what about leakage? It would difficult to control. There are many points that are found out in practice about motors, wiring, &c., that one would never think about.

I cannot understand what is meant by iron channels or rails ; if the writer means rails that box end of traveller or crab runs on, I might say that I have not seen any insulated, and that it is not necessary.

William Smethurst.

Motor Starters.

We have been interested in the correspondence now running in your journal upon the above subject, and feel that, as both makers and users of other forms of apparatus give them none too good a character, we may be permitted to say something on behalf of the "Ward-Leonard" motor-starters and controllers, in which we are interested.

These are not rated on such narrow margins, or in such peculiar ways, as we gather to be the case with others. Every starter is capable of carrying 50 per cent. excess of current (or, as one correspondent calls it, 125 per cent. overload) during a start which may take up to 2½ minutes (*i.e.*, five times 30 seconds). We think it most necessary to provide for the 50 per cent. extra current, in order to secure rapid acceleration in the motor and power to overcome the extra friction usually found in machinery after a stoppage.

Such margins as the above cover every contingency in ordinary practice, and, after the use of many hundreds of starters, it is found that not only "not once in 100 times" have any been burned out, but that they do not burn out at all.

It is true that the users of motors rarely study or advise us of the conditions of starting and working their motors, and for this reason we recommend the use of starters and controller combined with both a "no voltage" and interlocked overload circuit breaker, so that both motor and rheostat are protected from burning out, an arrangement which adds so little to the cost that we find a 5-H.P. starter costs under 9s. per H.P., and a 25-H.P. starter under 6s. per H.P.

There is very much to say on practical motor work under various conditions, but we fear to trespass too greatly on your space.

Geipel & Lange.

Westminster, *August 13th*, 1900.

In your last number Mr. C. B. Callow again returns to the charge. He alleges that my price of 10s. per H.P. is too low to allow of my supplying a motor starter which will not, "in nine cases out of ten," burn out. As to that, I can only suppose that Mr. C. is not practically acquainted with the "ironclad" type of starter, and although I admit that he would have a difficulty in getting an equally reliable starter at the price I name, can only add that I am perfectly satisfied to sell them at that figure, whilst the fact that not 1 per cent. of those issued come back for repairs, points to the fact that they do not burn out as he says.

If I could make certain that all starters were in the hands of competent men I should not worry my head about 50 per cent. *current* overload, nor do experiments made here show that there is any fear of failure if not practically used as a speed controller, and if he wishes to use a starter on machinery which he knows will take a considerable time to get going, *i.e.*, has heavy starting torque, then I emphatically say let the rheostat maker know it, and he will receive a special instrument to meet his requirements.

As to "Slim methods of catalogue ratings," I ask, why should the general user be handicapped by having to pay a high price for a starter which is only needed by the man who puts a 5-H.P. motor to do more work than it is rated for? Two horses can draw a tramcar, but no tramway engineer would equip an electric car with a 2-H.P. motor, or he would expect it to burn out if he did.

If Mr. Callow wants to start up his machinery and let it run long enough for the starter to dissipate the heat generated, the probability is both motor and starter will stand

it, but if he is going to keep starting and stopping like a tramcar, a printing machine or a crane, then a speed regulator, even at 30s. per H.P., would be better, and a specially-wound starter best, as being cheaper.

Douglas C. Bate.

London, *August 15th*, 1900.

The London County Council and their Tramways.

The *Daily Mail* of Friday, August 10th, contains an article by Mr. J. Allen Baker, of the London County Council. It will, no doubt, be remembered that a good deal of criticism was passed on the report of Prof. Alexander Kennedy which he made to the London County Council on his return from America.

Some time previous to that Mr. Allen Baker made a report to the London County Council. This contained some pretty pictures, mostly borrowed from manufacturers, but there was little, if any, information of any value contained therein. In this report Mr. Allen Baker stated his opinion that the conduit was the only possible system for London. Mr. Allen Baker again sings the praises of the conduit in his article in the *Daily Mail*. Mr. Baker seems to think that he alone is awake to the benefits of electric tramways. Had it not been for the London County Council, probably most of our London tramways would have already been running electrically. The County Council expert, Prof. Kennedy, seems to be but little better informed than Mr. Baker. To what extent he realises the advantages and possibilities of electric tramways for London may be seen by his report. In this he practically states that all that London will require in the way of tramways will be 200 miles of track with 500 cars running on them. Cities like Liverpool, Manchester, and Glasgow have all started with the idea that the conduit was best. After the most careful and searching investigation, they have unanimously adopted the trolley wire, and none have as yet regretted it. It is probable that no more complicated system than Liverpool could be found in London, or that there is any street along which there would be a more frequent service than is now to be found, say, in Lord Street, Liverpool. Ideal the trolley system is not, but in practice it has proved itself admirably suited, as put up in England, for all present needs.

To make a conduit satisfactory it must be rigid, and also before all things well drained, and the insulators, &c., must be accessible without disturbing the surface of the road. Under the most favourable circumstances, therefore, the excavation under the whole track cannot be less than 3 feet deep. Manholes and drains have to be provided for on an average at least every 150 feet, and the depth of the excavation which must extend under the whole track varies from 8 to 12 feet in depth.

Furthermore, at points and crossings the whole space occupied by the points and crossings has to be excavated and the roadway carried on pillars.

The earthwork necessary for conduit would practically block the whole street, as it is difficult to do one track at a time. At Brussels, where a conduit has been put in, the town was practically in a state of siege for two years, all the main streets being entirely blocked for traffic.

One of Mr. Baker's statements runs as follows :—

"In the trolley there must be a certain loss of electricity in working, which in a properly constructed conduit where both currents are conveyed by insulated bars is avoided. On the trolley you have the sparking of the wheels. This is unsightly, and frightens horses, besides causing a waste of electric power."

If the above is a sample of Mr. Baker's knowledge of engineering and electric traction, one feels sorry indeed for the undertaking for which he will be responsible.

As regards repairs, there are practically as many on a conduit system as with the trolley, and they are more difficult and expensive to make.

As regards working expenses there is little, if anything, to choose. We must, however, not lose sight of the depreciation, maintenance and sinking fund, which, in the case of the conduit, is much higher than in the case of the trolley system. The cost of feeders is higher in the case of a conduit, as the rails are not usually used as a return, and special return feeders become necessary.

Leaving the cost of feeders out of consideration, the cost of a trolley system, including track and overhead line, averages probably between £7,000 and £9,000 per mile of single track.

The actual cost figures, not including feeders but only conduit and track, for New York were $75,000 to $200,000 per mile of single track, and the average was certainly not less than $100,000. Or in other words, the conduit cost at least £10,000 more per mile of single track than the trolley. Therefore, for every mile of single track laid with the conduit, depreciation, maintenance, and sinking fund must be provided for £10,000, which would not be the case were the trolley adopted.

Mr. Baker concludes "that it is naturally to the interest of manufacturers of electrical appliances to advocate a system where the main expenditure goes to electric plant rather than where the greater part of the money does on the permanent roadway." It will be evident to even the non-engineer that Mr. Baker, "from his knowledge as an engineer," should realise that the electrical equipment, whether a conduit or trolley is adopted, remains the same. The same motor cars, generators and switchboard will be required, and the feeders will be heavier and the insulators far more numerous, as they are put every 15 instead of 150 feet, and two are used instead of one at each support. Mr. Baker therefore admits the much greater cost of the conduit, and that the experts in electric traction do not agree with him as regards the great advantages to be derived from the conduit.

The London County Council never has, and probably never will, err on the side of economy or common sense.

Something in the City.

[We are glad that our correspondent's remarks agree with our own comments made in another part of this issue. Indeed, criticism of Mr. Allen Baker's ridiculous and misleading tirade must necessarily follow the same lines when coming from those who have had experience of electric traction systems.—Eds. Elec. Rev.].

The Bury Electricity Supply Accounts.

In the analysis of our accounts for the year ending March, 1900, which you print in your last issue, I note that you wonder how it is that the items under "rents, rates and taxes" are less than for the previous year. You may, therefore, be interested to know that the reduction in the amount is due to the fact that, pending the result of an appeal against the assessment of the electrical department, an amount in excess of what was afterwards required was included in the accounts for the year ending March, 1899, and as the appeal was afterwards partly successful the past year's accounts benefit to the extent of the overcharge on the previous year.

S. J. Watson,
Engineer and Manager.

Electricity Works, Bury,
August 15th, 1900.

The Bradford Contracts.

We have noticed in your issue of August 10th R. W. Blackwell & Co.'s letter to the Mayor and Council of Bradford of the 30th ult. We have also read over your leader on this, entitled "Fair Play's a Jewel."

We beg to enclose herewith a copy of our letter to the Tramway Committee of Bradford, and also copy of the finding of their Tramway and Finance Committees.* We think that, in justice to all, you should publish our letter and the Tramway Committee's report. If it had not been for the correct interpretation of fair play by the Bradford Tramway Committee and engineers, we would not have received fair play in this contract, as it would have undoubtedly gone to R. W. Blackwell & Co., who submitted an amended tender, which formed the subject for the greater part of the Committee's investigations.

We firmly believe that you have been misinformed in this matter, and regret that you did not call our attention to the letter before writing your leader and comments.

Macartney, McElroy & Co., Limited.
J. F. Macartney, *Managing Director.*

London, *August 13th*, 1900.

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* See our other columns (pp. 253—255).

BUSINESS NOTES.

Electrical Wares Exported.

Week ending Aug. 15th, 1899.		Week ending Aug. 14th, 1900.	
Adelaide. Teleg. mat.	Value £1,675	Adelaide	Value £60
Amsterdam	30	Amsterdam	60
Bombay	52	Auckland	85
Brisbane	27	Buenos Ayres	299
Buenos Ayres	845	Calcutta	67
,, Teleg. mat.	279	,, Teleg. mat.	8
Calcutta	214	Cape Town	138
,, Elec. cable	288	Colombo	8
,, Elec. machinery	2,770	Constantinople. Teleg. mat.	45
,, Teleg. wire	71	Durban	278
Cape Town	434	,, Teleg. mat.	720
Christian'a. Teleg. mat.	988	East London	506
Colombo	40	Fremantle	167
Durban	164	Gibraltar	200
East London	273	Hamburg. Teleg. mat.	1,000
Fremantle. Teleg. mat.	242	Hong Kong	85
Genoa	460	Launceston	105
Hobart	330	Malta	100
Korsor. Teleg. cable	3,189	Ostend	420
Madras	27	Perth	85
Melbourne	95	Port Elizabeth	1,450
Ostend	46	Shanghai	406
Port Elizabeth	1,646	Stockholm. Teleg. mat.	306
,, Teleg. wire	105	Sydney	1,058
Port Said	16	Wellington	259
Rosario	57		
Rotterdam. Teleg. mat.	35		
Singapore	104		
St. Petersburg. Elec. motors	67		
Stockholm. Teleg. mat.	1,205		
Sydney	24		
Trinidad	15		
Wellington	204		
,, Teleg. mat.	80		
Yokohama	53		
,, Teleg. mat.	671		
,, Teleg. wire	671		
Total	£17,522	Total	£8,010

Foreign Goods Transhipped.

Durban. Telephones	Value £29	Calcutta. Elec. goods	Value £35
Paris. Elec. machinery	80		
Trinidad. Teleph. apparatus	39		
Total	£148	Total	£35

Bankruptcy Proceedings.—W. V. Scott, electrical engineer, Shaftesbury Road East, Hammersmith, W., has been adjudicated bankrupt.

Books Received.—"Canadian Trade Index." The classified membership directory of the Canadian Manufacturers' Association, 1900. Board of Trade Building, Toronto, Canada.

Quarterly Journals of the Royal Meteorological Society for January and April, 1900. London: E. Stanford. 5s. each.

"The Universal Directory of Railway Officials, 1900." Compiled by S. Richardson Blundstone, editor of "The Railway Engineer." London: The Directory Publishing Company, Limited. 10s.

Catalogues and Lists.—The Unbreakable Pulley and Mill Gearing Company, Limited, send us lists of their pulleys, friction clutches, swivel bearings, and other specialities.

Messrs. Poth, Hille & Co., of Leadenhall Street, send us an advance copy of their list of specialities, including the "Empress" self-vulcanising jointing, for packing steam, hot water, and other joints. This jointing is stated to have been tested under very severe conditions in electric light stations and to have proved itself specially suitable for this class of work. It is claimed to be a sure cure for troublesome joints. The firm also manufacture corundum and emery wheels and grinding machines, also asbestos and india-rubber goods.

The General Electric Company, Limited, have issued new lists of multipolar motors and lift controllers which are to be incorporated in their complete bound list, a new edition of which is in course of preparation. Consulting engineers, contractors, and others interested may obtain copies of the lists on application at the offices.

The B.T.H. have brought out pamphlet No. 71 in which the Thomson tramway and portable "recording wattmeters" are particularised.

The tenth edition of the General Electric Company's catalogue of wires and cables, casings, conduits, insulators, and wiring sundries has been issued. All wires and cables for electric light, bell, and telephone work are dealt with exhaustively, whilst in useful rotation follow prices and particulars for casings, conduits, insulators, wiring accessories, and tools, the object of this special arrangement being easy reference for purchasers of these particular classes of material, which usually go hand in hand. Points of special note are the introduction for electric lighting of twin paper insulated lead-covered wires and cables, and also twin vulcanised wires and cables, which are now, of course, in great demand for conduit systems. The various systems of conduit are clearly enumerated, more especially the "Union" system which is now coming into universal use. A novel feature with regard to conduits is the patent adaptor blocks shown on page 232 for joining conduit to casing in a neat and workmanlike manner. Various new types of high tension insulators are also shown.

An exceedingly neat pamphlet, with small and pleasing illustrations of their manufactures shown at the Paris Exhibition, comes to hand from the Compagnie Internationale d'Electricité, of Liège.

Messrs. Graham, Morton & Co., Limited, have brought out a new illustrated catalogue of their patented elevating and conveying machinery. A number of photographic reproductions are shown of plants of this character erected by the company, and they include coal elevating, storing, screening and conveying machinery applied to certain large electric light stations in London and elsewhere. The list should be of interest to electric light station designers and engineers at the present moment, when mechanical devices for fuel-handling are being so widely adopted.

Chapman Voltage Regulator.—Messrs. Geipel and Lange, of Westminster, have been appointed sole agents in this country for the above regulator, which they have used on several power installations, and found to be most desirable apparatus for keeping voltage constant under the demands met with in motor installations, making, in the ordinary way, simultaneous supply of lights in the same mains almost an impossibility. The regulator consists of three essential parts—(1) the relay, (2) the working solenoid, and (3) the resistance. The relay takes note of the variations in the line voltage, and is connected to the lines either directly or, in high tension work, through a transformer, if line drop has to be compensated for, the relay is also wound with some turns of the main circuit. The movement of the relay controls the working solenoid. The working solenoid operates the contact fingers on the resistances, it contains a core which forms a plunger in an oil circulating system. The plunger is connected to the contact fingers. The rapidity of movement is regulated so as to harmonise with the nature of the field by means of a bye-pass in the oil circulation. The winding of the solenoid is specially arranged to prevent sparking at the relay contacts whilst giving powerful control. The resistances are connected in the field circuit of the generator, and are specially made to suit the same.

Simplex Tubing.—Messrs. C. & A. Musker, Limited, of Liverpool, write to us as follows:—"On the 3rd inst. this district experienced the most severe storm known for 18 years. Amongst other damage done, a length of some 40 feet of the wall of our new works was washed away into a clay pit near. The cables supplying current, for both light and power, to our foundries were supported by this wall, and we enclose a photograph showing the damage done. This photo is particularly interesting just now, when opinion is divided as to the best form of protection for cables. Simplex enamelled steel tubing was the protection adopted, and

when the stress caused by the *debris* came upon the tubes, they opened at the joints, and the cables were undamaged. Motors giving some 50 H.P. continued running without interruption. We do not hold a brief for the Simplex Company; but we are of opinion that, if we had employed any form of tube with screwed joints, the cables would have been broken and work in our foundries stopped. We may mention that our pattern stores, which were built next the wall, were completely demolished, and the patterns, shelves, roof, &c., swept through the gap over the cables."

Changes of Addresses.—The offices of the electric light department of the Hull Corporation are now at the electric light station, Sculcoates Lane, Hull. All communications should be addressed there, as the Dagger Lane offices are closed.

Mr. A. R. Bennett, M.I.E.E., has removed from 44, Manor Park, Harlesden, London, N.W., to 55, West Regent Street, Glasgow.

Davey, Paxman & Co.—The members of the Ipswich Engineering Society visited the works of Messrs. Davey, Paxman and Co., Colchester, yesterday afternoon.

Electric Driving.—A contemporary states that Messrs. Bolckow, Vaughan & Co. are engaged in the erection of a large plant for the electrical driving of a lot of the machinery used in their rail and plate works at Eston, near Middlesbrough. The plant for the generation of power is being erected at the end of the company's jetty on the Tees, nearly a mile from the steelworks to which the power is to be applied. The whole of the electrical plant is being supplied by the Westinghouse Company. The first electrical installation to be provided will give 1,500 H.P. for the operation of the cranes, shears, straightening and other machines employed in and about the steelworks.

Electricity in Shipbuilding Yards.—Messrs. Wm. Denny & Brothers, Dumbarton, are making extensive improvements on the electric plant in their shipbuilding yard.

The Equipment of New Locomotive Works.—The *Newcastle Daily Chronicle* learns from official sources that the contracts have been let for the new locomotive works of R. Stephenson and Co., Limited, at Darlington. Those for steel staunchions and girders are let to the Teeside Bridge and Engineering Company, Middlesbrough; for the electric light and power installation, Messrs. E. Scott & Mountain, Limited, Newcastle; for two electric cranes, 50-ton, Messrs. Craven Bros., Manchester; for 11 electric cranes, 3-motor, from 6 to 15 tons, Messrs. T. Broadbent & Sons, Limited, Huddersfield; and for Lancashire boilers, Messrs. Tinker, Shenton & Co., Manchester.

Liquidations, Dissolutions, &c.—A meeting of the Electric Automobile Syndicate will be held on October 3rd to hear an account of the winding-up proceedings from the liquidator, Mr. Albert Brown.

A meeting of W. C. Bersey & Co., Limited, is to be held at 34, North Street, Manchester Square, London, on September 17th, for a similar purpose. Liquidator, Mr. W. C. Bersey.

The Sussmann Electric Miners' Lamp Company, Limited, is winding up voluntarily for the purposes of reconstruction. The new company will have the same name. Mr. R. Warner is liquidator.

The first meetings of creditors and contributors of the Willoughby Destructor Syndicate are to be held on August 22nd, at 33, Carey Street, W.C.

Messrs. W. A. Shaw and E. A. Shaw, electrical engineers, Warren Street, Stockport, have dissolved partnership. Mr. W. A. Shaw attends to debts.

New Works.—It is stated that extensive new ironworks are to be constructed near Bolton by Messrs. Musgrave. They will cover six acres.

Outing.—On Saturday, August 4th, the employés of Messrs. Belshaw & Co., manufacturing electrical engineers, of Chapel Street, S.W., held their annual beanfeast at Staines. The large number of country jobs prevented a good many from attending. After dinner sports were enjoyed.

Non-magnetic Watches.—A large photograph of the exhibit of Messrs Smith & Son, Limited, Strand, W.C., at the Paris Exhibition has been sent to us. Their show of non-magnetizable and other watches and clocks is of great value, and no doubt has commanded considerable attention. A copy of their handbook in French and English containing an extract from the official catalogue of the exhibition, gives particulars of their manufactures there on view.

Plant for Sale.—The Derby Corporation is advertising for sale two 60-kw. steam alternators, and exciter sets. See "Official Notices" to-day.

Release of Trustee.—Notice is given of release of trustee (Mr. W. M. Richards) in *re* W. A. Charles and J. S. Blackwell (Central Electrical and Engineering Company), of Leicester.

Rise in the Price of Lead.—The Tudor Accumulator Company, Limited, announce, owing to the continued rise in price of lead, they are obliged to increase all their list prices from this date by 5 per cent. As soon as the state of the lead market will permit it, this advance will be cancelled.

South Africa.—The *British and South African Export Gazette* says that an electric lighting plant, sufficient to supply 6,000 lights, will probably shortly be ordered for Salisbury, Rhodesia. The placing of orders for accumulators for the electric lighting installation at the Maritzburg new Town Hall, at an estimated cost of £4,431, is under contemplation. It has likewise been decided to procure in this country a supply of reserve cable to the value of £2,309. An order has been placed by the Durban Town Council with the Electric Construction Company for an additional generator.

Trade Announcements.—To enable them to cope with their extending business, Messrs. G. Straus & Co., Limited, have removed from 130, Queen Victoria Street, E.C., to more extensive premises at 211, Upper Thames Street, E.C., where in their electrical department a well assorted stock of lamps, cables, and wires, batteries, bells, and other electrical accessories is kept.

Also to cope with increased business in the Midlands and to facilitate deliveries, Messrs. Bergtheil & Young have decided to open a Manchester branch at 26, Deansgate Arcade. Here they will keep a stock of "Bandy" motors and generators, tramway equipment supplies, insulating materials and other electrical specialities. Their July list of "Bandy" electric fans and ventilators is now before the trade.

ELECTRIC LIGHT AND POWER NOTES.

Albury.—The Parish Council seems inclined to take a supply of electrical energy for public and private lighting in the parish from the Guildford Electric Light Company, who are agreeable to charging the same price per unit as is paid by the Guildford inhabitants.

Ashton-under-Lyne.—The Town Council has resolved to abandon the maximum demand system in favour of a flat rate of 4½d. per unit for lighting purposes.

Bangor.—The completion of the electric light works has been delayed by various causes, but it is hoped to have steam up at the end of this month.

Beverley.—The Corporation has decided to apply for an electric lighting provisional order. Two private companies gave notice of similar applications, and the action of the Corporation is taken with a view to safeguarding its rights. The Council owns the gasworks. We trust it does not propose a blocking policy.

Brecon.—The Mayor (Colonel Morgan) has obtained a provisional order at a cost to himself of £500, and is presenting it to the Council.

Carmarthen.—The Town Council is not getting on very well with the gas company, and has decided to obtain expert advice on the question of electric lighting.

Carnoustie.—The Burgh Commissioners will oppose the application of the Shields Supply Company for a provisional order, but will make inquiries in other towns to see whether electric lighting is likely to pay.

Chatham.—The Town Council has resolved to appoint Mr. Manville to advise as to the value of the local company's undertaking.

Dewsbury.—The annual abstract of accounts just issued shows that for the year ending March 31st last the income on the electricity revenue account was £4,331, and included £3,862 for energy sold. After deducting expenditure there was a balance of £1,741 to carry to the net revenue account, which shows a credit balance of £201. On capital account the expenditure totalled £6,465, and included £1,567 for buildings, £2,877 for mains, and £1,287 for steam dynamo.

Dublin.—A deputation from the Corporation of Dublin left that city last week for the purpose of inspecting and reporting on the systems of electric lighting in operation on the Continent. In addition to the members of the Corporation some of the officials concerned in the working of the scheme accompanied them. These were Mr. Hartz, the city engineer; Mr. Ruddle, the city electrical engineer; and Mr. Hammond, the consulting electrical engineer, under whose supervision the present scheme is being carried out. The deputation will visit several of the leading German and French towns where electricity is in use.

The Corporation has adopted a recommendation of the Electric Lighting Committee for a supplemental loan of £10,400 to cover cost of additional works under a loan already sanctioned.

Dumbarton.—The Public Lamps Committee considered the scheme of electric lighting proposed by Mr. Provand, of Edinburgh, and the Council has resolved that the scheme be not adopted.

Fakenham.—The price of gas having been raised (it is now 6s. 6d.!), the townspeople are taking steps with a view to adopting electricity.

Filey.—The Urban District Council is making inquiries with a view to applying for a provisional order.

Glasgow.—The Electricity Committee issued on 13th inst. the eighth annual report and balance-sheet in connection with the Corporation electricity department, which embraces the year ending May 31st, 1900. The gross revenue amounted to £59,762 2s., and the gross or working expenditure to £34,999 15s. 11d., to which must be added £3,181 10s. 11d. for depreciation written off capital. The balance carried to profit and loss account was £21,580 15s. 2d., out of which the committee had to meet the following obligations:—(1) Interest on loans, £15,256 0s. 7d.; (2) sinking fund £6,285, thus leaving a balance of £39 14s. 7d., which has been carried to reserve. The committee makes the following recommendations as to the charges for the supply of electrical energy during the ensuing year, 1900-1901. (The charges under heads IV., V., and VI. have already been approved of by the Corporation. The others, I., II., and III., were probably approved at the Corporation meeting yesterday.)

I.—Under the demand indicator system:—

Prices per Board of Trade Unit.

Quantity consumed.	Any voltage.	100 volts.	200 volts.	250 volts.
1. Not exceeding 365 hours per annum	6d.	..	..	..
2. Exceeding above quantity	..	2½d.	2d.	1½d.

II.—Fixed charge system:—(1) A fixed charge of 4s. 6d. per annum for each 8-c.p. (32-watt) lamp, or its equivalent, fixed in consumers' premises (or £7 0s. 8d. per kw.) for 100-volt supplies; 4s. 4d. per 8-c.p. lamp fixed (or £6 15s. 5d. per kw.) for 200-volt supplies; and 4s. per 8-c.p. lamp fixed (or £6 5s. per kw.) for 250-volt supplies, this charge being spread uniformly over the 12 months. (2) An additional charge for all energy used as recorded on the meter at the rate of 1½d. per Board of Trade unit.

III.—All consumers who take a supply for the equivalent of five hours or more per day for 365 days per annum to be charged throughout at the rates of 2½d. per unit for 100-volt, 2d. for 200-volt, and 1½d. per unit for 250-volt supplies.

IV.—A special rate of 3d. per unit to be charged for supply to churches.

V.—For domestic consumers only, a uniform charge of 3½d. per unit for 250-volt supplies and 4d. per unit for 100-volt and 200-volt supplies to be made, without the use of the demand indicator.

VI.—For motive power purposes only, subject to such conditions as may be necessary, a uniform charge of 1½d. per unit for 250-volt and 2d. per unit for 200-volt consumers to be made, also without the use of the demand indicator.

The quantity of electricity sold to private consumers during the past year was 3,788,795 units as compared with 2,566,016 units during the previous year, being an increase of 47·65 per cent.

	May 31st, 1899.	May 31st, 1900.
Number of consumers	1,858	2,852
Number of consumers using over five hours per day		162
Number of motors supplied	78	212
Arc amps in use in public streets	227	265
Street lighting—B.O.T. units	258,334	461,874

The following report of progress has also been issued.—About 200 feet of Port Dundas station has now been completed, or about one-third of what the station will be when complete. The temporary wooden sheds over which the buildings were erected have been removed for some time.

Total steam power available at May 31st, 1900, at Port Dundas station was approximately 7,000 H.P., which, with 3,300 H.P. at Waterloo Street station and 2,200 H.P. at Pollokshaws Road Station, will give an increase of approximately 6,700 H.P. to meet the coming winter's demand, as compared with that of last year. A further extension of plant at Port Dundas is on order of about 5,000 H.P., and this is expected to be in working order before May 31st next. For Pollokshaws Road station two engines and dynamos of the aggregate power of 2,200 H.P. will be available at the close of the Exhibition in October, 1901. Twenty miles of new feeders and 20 miles of distributing mains have been laid during the past financial year (mostly of the B.I.W. Company's paper insulation three-core concentric cable) on the north side of the river Clyde, and about 7 miles of feeders and 5 miles of distributing mains on the south side of the river, all in addition to what has already been laid prior to May 31st, 1899. The undertaking of the Kelvinside Electricity Company, Limited, passed into the Corporation's hands in August, 1899; the committee are now putting in 1,000 H.P. of new plant to meet the rapidly-growing demand of the Kelvinside district.

Although the increased demand for electricity for the past year amounts to something like 1¼ million units, the committee of the gas department are recommending that an additional loan of £1,000,000, making a total of £3,000,000, be obtained under the Gas Acts.

The Electricity Committee have authorised Mr. Chamen to advertise for about 16,000 tons of coal to supply the generating stations till the end of May, 1901.

Bridge of Allan.—The Commissioners have objected to the notice of Edmundson's Electricity Corporation intimating that they intended to apply for an order for the electric lighting of the burgh. The intimation was received by the Commissioners on July 2nd, which was beyond the statutory time for giving notice, and they intimated to Edmundson's Corporation that they could not accept it. In reply Messrs. Edmundson's stated that the notice was posted by registered letter on Friday, June 29th, and on inquiry they were informed by the Post Office that it should have been delivered by first post on Saturday morning. They had no doubt that this explanation would be sufficient to satisfy the Board of Trade that their intentions in the matter were perfectly honest.

Harwich.—Notice of transfer of the Council's electric lighting order to the Harwich Electric Lighting and Tramways Company, Limited, appeared in the *London Gazette* for August 10th.

Hapton (Burnley).—Messrs. Simpson Bros. will light this district electrically from September to April under contract with the Council, for £122.

Honley.—The District Council has resolved to purchase the gasworks, but to include in the provisional order powers for electric lighting. The North British Electric Supply Company has given notice of its intention to apply for an order.

Lincoln.—The governors of the Lincoln County Hospital have decided to introduce an installation of electric light into the building. The Lincoln Corporation are the owners of the principal electricity supply in the city, but the governors considered that as they were contemplating a large expenditure upon machinery for a new laundry and warming apparatus, it would be a considerable saving if the opportunity were also taken to make the engines and boilers additionally powerful so as to allow of an electric light installation. Mr. C. S. Vesey Brown, the Corporation electrical engineer, has undertaken to give any advice that the hospital authorities may require in the matter.

London.—St. George's, S.W.—The Vestry has decided, on the report of Sir W. H. Preece, to adopt an offer of the Westminster Electric Supply Corporation, Limited, for the street lighting.

Maidstone.—The Local Government Board having notified the town clerk that they desired the opinion of an independent expert as to the electric lighting scheme (which was prepared by Messrs. Stevens & Barker, Maidstone), the Town Council has decided to ask Sir Wm. Preece to report as to it. It is hoped that the installation may be carried out by February or March next.

Manchester.—The Electricity Committee of the City Council in their report for the year ended March 31st state:—The number of consumers at the close of the year was 3,240, representing an increase of 670 as compared with the preceding year. The total number of lamps connected was—incandescent (of 8 C.P.) 237,145, arc 2,139, as compared with 188,999 and 1,817 respectively. There were also in use 500 motors, representing 2,050 H.P., showing an increase on the previous year of 166 motors, equivalent to 890 H.P. The maximum load at any time during the year was 5,607 KW. During the past year additional mains have been laid to the extent of 47 miles 530 yards, making the total length laid at March 31st 110 miles 45 yards. The revenue derived from sale of energy, &c. (which works out at 3·20d. per unit accounted for) amounts to £86,298, and the working expenditure to £49,906, showing a gross profit of £36,392, and a net profit of £9,183. The surplus, together with a balance of £2,000 brought from last year's account and £572 interest on reserve fund investment, making a total of £11,765, has been appropriated in the following manner, viz., paid to city fund, in aid of rates, £10,000; placed to reserve fund, £1,765. Owing to the necessity for renewing a considerable length of mains which had proved defective, the charge upon revenue account for repairs and renewals of mains this year amounts to £7,454, as against £1,496 last year. In addition to this, the sum of £12,460 has been taken from the renewals suspense account to cover similar expenditure.

The accident which happened to the machinery of Dickinson Street station in September last did considerable damage to a portion of the plant installed there. Two 400-H.P. engines and dynamos were completely wrecked; whilst other engines, a switchboard, a range of steam pipes, and the building, were also damaged. The amount withdrawn from the reserve fund on account of the breakdown is £7,070.

Newport.—The town clerk has been authorised to enter into negotiations for the lands required for the approach roads to the transporter bridge to be erected over the River Usk, and for the lands required for the erection of the new electric power station. The bridge, similar to one in operation at Rouen, is to be erected to the plans of M. Arnodin, a French engineer. The cars will be worked by electricity, and provision is to be made for a duplicate source of power for working the bridge either when the electrical generating plant is not running, or in case of failure of supply, by the installation of storage batteries sufficient to run the bridge in such events.

The office manager of the Corporation electricity works has been authorised to visit other towns in order to obtain material for a report on the different methods of free wiring in operation.

North London District.—The result of the conference of local authorities, held recently, is that Tottenham, Edmonton, Wood Green, Southgate, Enfield, Finchley, and Friern Barnet have resolved to form a joint committee for the promotion of a Bill in the next session of Parliament empowering the committee to supply electricity in the municipal areas mentioned.

Middlesbrough.—It is expected that the electricity works will be so far completed as to give a temporary supply in October.

Penistone.—The District Council has decided to meet the Penistone Board of Guardians and the Thurlstone Council to consider the advisability of installing electric light in the district.

Rathmines.—This important Dublin suburb has an independent electric scheme of its own, which is on trial during this month, being turned on for testing purposes each night. The householders who have had their premises wired, are being given a supply free of charge during the month.

Roundwood Collieries.—The electrical plant at these collieries has been extended underground for haulage and pumping purposes. Coal cutting machines, worked by electricity, have been introduced.

Ryde.—On the 8th inst. Lieut.-Col. A. C. Smith, R.E., Local Government Board inspector, held an inquiry, which lasted five hours, into an application of the Corporation for sanction to a loan of £30,000 for the purposes of electric lighting. Mr. C. C. Hutchinson, who appeared for the Corporation, said that Ryde, which at the present time had a population of 13,000, had for some years been considered an exceedingly good hunting ground for electric light companies; it was intimated by Major Cardew, who held an inquiry, that unless the Corporation applied for powers themselves, they would eventually be granted to some other persons. Councillor Barton, chairman of the Electric Light Committee, stated that he had supported the scheme because he considered that if a company were so anxious to come to the town there was some possibility of making a profit. Mr. Manville gave evidence with respect to his estimates and plant. He had not the least doubt that the Ryde scheme would be financially successful. He thought electric light enterprises were managed more economically by municipal authorities, and a pleasure resort like Ryde was eminently a place for an electric light installation. Mr. Shaw, who conducted the opposition, addressing the inspector, laid stress on the fact that a majority of the people who voted at the public meeting were against the Corporation trading in electricity. Mr. Hutchinson having replied, the inquiry was closed.

Salford.—There were 34 applications for the position of electrical engineer to the Salford Corporation, and from these the Electric Light Committee selected five names, viz., Neville Appelbee, of Cardiff; H. Parker, of Wolverhampton; S. J. Watson, of Bury; A. A. Day, of Manchester; and J. Moss, of Eccles. It is stated that Mr. Appelbee has been appointed, pending inquiries.

Portsmouth.—The Electric Lighting Committee have recommended that a 500-KW. alternator be purchased from Messrs. Parsons & Co. for the sum of £5,300, it being agreed that they shall take back the old alternator and allow £1,200. During the last two winters, the Committee reported, they had been dangerously short of plant, owing to the difficulty—in fact, impossibility—of getting machinery in what was then considered reasonable time, with the result that on more than one occasion they were unable to maintain the total supply. The Committee, therefore, thought it imperative to look farther ahead and forecast the probable maximum demand for the winter of 1901.

Provisional Orders are to be sought for—

BEVERLEY.—By the Town Council.
WELLINGBOROUGH.—By the District Council.
WISBECH.—By the Town Council, the North British Electricity Supply Company, and the United Electric Light and Traction Company.
KEARSLEY.—By the South Lancashire Supply Company, Limited.
HUNTINGDON.—By the North British Electricity Supply Company.
DORCHESTER.—By the Town Council.
WORSLEY.—By the District Council.

Scarborough.—Negotiations are in progress between the Scarborough Electric Supply Company and the Town Council respecting the latter's proposal to purchase the undertaking.

Sheffield.—The Electric Light Committee reports that for the six months ending June 30th, 1900, the number of 8-C.P. lamps applied for was 13,551; the number of applications was 175; number of 8-C.P. lamps connected during the half-year, 9,585; units generated, 999,377—an increase of 34·1 per cent. Receipts for units sold (meter rentals omitted) 761,776 units—£12,228; increase, 39·8 per cent. Cost per unit (works cost only and distribution), generated, ·869d.; metered, 1·11d. Increase: generated, 20·5 per cent.; metered, 14·4 per cent.

At the last Council meeting Ald. Styring said the Electric Light Committee had found the question of leading-in services to consumers' premises a matter of considerable irritation; consumers were ready to take the light, but they objected to the cost of connecting with the mains. The engineer had gone very carefully into the matter, and he found that, without making any serious sacrifice, the irritation might be done away with. The committee therefore recommended a modification of practice which, he was sure, would be very much appreciated. In future consumers would have the service laid in to a distance of 30 feet without any special charge being made. In the case of premises situated a longer distance away, it was thought reasonable that some charge should be made, and it was proposed that that charge should be the actual cost price. He (Ald. Styring) wished to give a warning in regard to the capacity of their supply. A week or two ago there was a breakdown in the last-installed machine at the station. That breakdown was of a serious character, and it was just possible that they might be in some difficulty as to keeping up the supply until the alternator, which was now being erected, was completed.

Stockton.—The Council has informed the South Durham Steel and Iron Company that it will supply electricity for motive power purposes at the malleable iron works at 1·2d. per unit up to a maximum of 200 H.P. with a minimum payment of £150 per quarter. An amended tender of the Brush Electrical Engineering Company for arc lamps, &c., at £500 has been accepted. Mains extensions have been arranged for at a cost of about £2,100. The erection of machinery and the laying of cables are nearing completion.

Sudbury.—The Town Council are taking steps to carry out the electricity scheme of Mr. W. C. C. Hawtayne. It is proposed to use a refuse destructor, and it is believed that when the installation is completed electricity will be adopted for motive power in the weaving factories. At this week's meeting of the Town Council a report was presented by the Electric Lighting Committee recommending the Council to give instructions for the preparation of plans, specifications, and estimates, and that application be made to the Local Government Board for a loan; also that a site be purchased for £1,500. The report was adopted. The work is to be carried out at the same time as a new sewerage scheme to avoid a second breaking up of the roads. The provisional order received Royal assent a short time ago.

Sunderland.—The Lighting Committee has decided to recommend the Council to proceed at once with the work of building a new electric station.

ELECTRIC TRACTION NOTES.

Birkenhead.—In this district the work of constructing electric tramways and plant is being carried on vigorously. The tender of Messrs. Hughes & Stirling, Bootle, for the construction of a car shed in connection with the electric tramway service in Laird Street has been accepted by the Tramways Committee of the Birkenhead Town Council.

Birmingham.—*Commercial Intelligence* says that the agreement between the Corporation of Birmingham and the City Tramways Company relating to the erection of the overhead system in Bristol Road has been formally and legally concluded under the seals of these respective bodies. The Tramway Company are now using their best efforts to procure the necessary material in order that the conversion of the line may be brought about at the earliest possible moment.

Black Country.—The electric tramways which have been constructed from Cradley Heath to Old Hill, Netherton, and Dudley have now been completed at least a month; great surprise is being expressed that they have not been opened for traffic yet. The explanation is this, that the British Electric Traction Company are unable to move until after the official inspection on behalf of the Board of Trade.

Bowness.—It is stated that after objecting to the tramway scheme of the British Electric Traction Company, the Bowness District Council has accepted a modified scheme by a majority of one.

Darlington.—According to the *Times*, since the opening of the Stockton and Middlesbrough Electric Tramways two years ago the public of Darlington have been looking forward to the time when their present system of horse traction should be replaced by a system of electric tramways. Negotiations were opened with the Imperial Tramways Company (who own the present tramways), and 12 months ago an inquiry was held by the Light Railway Commissioners, at which apparently the Corporation and the tramways company agreed as to the terms on which Darlington should be put in possession of 10 miles of electric tramways (at a cost of £120,000). The only point on which it seemed likely that there would be any difference of opinion was that of the supply of the current, the tramways company favouring a method by which the current should be transmitted from their existing works at Stockton (12 miles distant), and the Corporation desiring to supply the motive power from their own generating station, now rapidly approaching completion, for electric lighting purposes—in Darlington. Prof. Kennedy was called in to advise and report as to the price he considered reasonable should be paid by the tramways company for such supply. The secretary to the Commissioners wrote to the Corporation on April 18th inquiring whether any agreement had been come to, and he was informed that the company had agreed to take electrical energy from the Corporation, with the proviso, however, to which the Corporation could not agree, that the company should be allowed a considerable extension of the periods within which it had been provided that the various sections of the line should be laid down. An interview was then arranged between the secretary of the Commissioners and representatives of both the Corporation and the tramways company, at which it was stated that the Corporation would not have supported the application of the company at the inquiry before the Light Railway Commissioners in the manner they did had there been any suggestion that the company would seek a modification of the original scheme. The Corporation attached much importance to the arrangement to supply the company with electrical energy. The secretary to the Commissioners intimated that they would possibly grant an extension for the laying down of a considerable portion of the system. Another disputed point here arose as to the allocation of a sum of £5,000 which the company had agreed to contribute towards the cost of street widening. After the conference the company's representatives intimated that, though they were not prepared to do anything further towards street widening, they would hand over the provisional order, when obtained, to the Corporation and dispose of the present tramway undertaking upon advantageous terms. Much correspondence ensued between the two bodies on this and other points, and eventually the Corporation thereupon resolved that the Commissioners be informed that in the event of the company not being prepared to carry out the scheme the Council would make application for a new order at an early date. The matter is thus at a deadlock, neither party showing any disposition to recede from the position taken up.

The Edinburgh Cable System.—Our Edinburgh correspondent sends us the following:—In bright relief to the Edinburgh car-cable system stand out the electric cars at Dundee. These Dundee cars are new, only within the past fortnight has the service been set agoing; and at the meeting of the Town Council the other day, the license from the Board of Trade was read. Ex-Provost Brownlee said the cars had been a great success, and had worked exceedingly well. Horse traction had cost 6d. per car-mile, whereas by electric traction the cost had been reduced to less than 1½d. per car-mile. Of course, also there was a great saving in causeway blocks and in cars, for four of the new cars could do the work of six of the old ones. This is a happy state of affairs, and all the more so when Edinburgh is brought under notice. The cable cars in Edinburgh have so far been a comparative failure. After several years' labour the full system is not in operation yet, and the lines that are working are a serious annoyance to passengers. Continual breakdowns and stoppages are the fate of the traveller; he may start, but he knows not when he arrives. Nothing like a regular service can be maintained, and the cars get bunched together. The drivers do not seem to be able to understand the working of the different junctions and auxiliary cables, and are kept on a nervous tension which may probably account for some of the very stupid things they do. The conductors are disheartened, and long for a return to the old horse traction days, although after the enormous expense of cabling the streets, that is an impossibility. Those at the head of affairs say that time will improve everything, but at the recent annual dinner of the Merchant Company it was freely admitted that the adopting the cable system in preference to the electric had been done too hurriedly. It was explained in defence of the cabling that Edinburgh was a romantic city which

could not afford to sacrifice her good looks for the sake of electric cars. This reason was not received with any great sympathy. How the cars are going to pay the tramway shareholders is a mystery to many minds. The annual rent to the Edinburgh Corporation is £90,000, and for the past two years the tramway company have paid no dividend; last year, indeed, left a loss on the 12 months' work. A strike of the tramway employés was looked for, and a week's notice had been handed in by the men, but a timely increase of 1s. a week to all drivers and conductors has saved the long-suffering Edinburgh citizens from an even worse state of locomotion than at present. The success of Dundee only makes the position of matters more annoying, for there are many men who advocated the electric traction, or, at any rate, a period of delay, and who are now pointing to the disorganised cable system, and asking if anything could be worse than that.

Gosport.—At the last meeting of the District Council the Roads and Works Committee submitted a recommendation that a letter be written to Mr. A. W. White, manager of the local tramway, informing him that the Council are not prepared to enter into any negotiation to acquire the tramway, or into any arrangement with the company to promote a Bill in Parliament for the extension and conversion of tramways, &c. The recommendation was adopted. The Council then considered the defective state of the tramlines and the danger to vehicular traffic, and it was resolved to call upon the company to carry out the necessary repairs at once; in default, the attention of the Board of Trade to be called to the matter.

Halifax.—Lieutenant-Colonel Van Dunlop, from the Board of Trade, made an inspection of the Stump Cross branch of the Halifax tramway on August 10th. He also went over the King Cross line at the request of the Tramways Committee, and in connection with this section of the system, it was urged that the compulsory stopping places are too numerous, and that if they were reduced the public interests would be better served.

Liverpool.—At the City Coroner's Court on 10th inst. the adjourned inquest was held on the body of a general labourer in the employ of the Corporation tramway department, who was killed by the fall of an electric wire and its attachments in Robson Street, on Friday last week. The Coroner said that the necessary evidence had not been completely got together, and it would be necessary to further adjourn the inquiry until 23rd inst. The Board of Trade would have to be communicated with.

Malvern Hills.—A syndicate has been formed to supply a mountain railway up the Malvern Hills. Electrical rather than steam power is favoured by the Hills Conservators, to whom a preliminary communication has been forwarded on the matter.

Morecambe.—Plans and estimates are being prepared by the manager of the electricity works, for the application of overhead traction on the Morecambe Tramways Company's lines, which are at present worked by horse traction.

Newport.—The Lighting and Traffic Committee have resolved that a power station for the tramways and other purposes be erected on the Corporation Road site. The question of the appointment of an engineer for the erection of the power station, the machinery and plant therein, and the electrical equipment of the lines, was considered, and it was agreed that Mr. H. F. Parshall be asked upon what terms he would be prepared to accept the appointment for carrying out a scheme upon the lines of his report submitted in October last.

Messrs. Nicholas & Co., timber merchants, of the Baltic Wharf, Newport, have installed an electric light plant and machinery. The new premises of the *South Wales Daily Telegraph*, a new Newport newspaper, will be lighted by electricity, and the machinery will be driven by electric motors.

Sunderland.—The official inspection of the Christ Church—Roker section of the Sunderland tramways took place last week. Colonel Yorke and Mr. Trotter, of the Board of Trade, together with the Mayor, Alderman E. R. Dix; Mr. T. Summerbell, vice-chairman of the Tramways Committee; Mr. J. F. C. Snell, borough electrical and tramway engineer; Messrs. Begg, C. Schultz and E. Hurlebat, for the contractors; and Mr. W. Morrison, traffic manager, entered an electric car which was run over the section. A careful and minute inspection was made of the permanent way, the termini and the distances. The car sheds and the power station were visited, and the Board of Trade officials proceeded to inspect the routes not yet completed. The Corporation decided to run the cars regularly from Wednesday on this route, and take the responsibility until the notification from the Board of Trade arrives.

Sutton and Howth.—We read in a Dublin paper that the power station and its equipment for this electric tramway are practically finished.

TELEGRAPH AND TELEPHONE NOTES.

Cable Interruption.—Reuter's Madrid representative says that cable communication between Las Palmas and Teneriffe has been interrupted.

Glasgow and the National Telephone Company.—In the House of Commons last week Mr. Provand asked the Secretary to the Treasury, as representing the Postmaster-General, whether the National Telephone Company have intimated to the Postmaster-General that they agree, in terms of Section 3 of the Telegraphs Act, 1899, to it being made a condition of their license that they will not give preference to any person within the area specified in the license by the Postmaster-General to the Corporation of Glasgow, and will not within that area, as a condition of giving a service, require any person to grant any facility except for the purposes of supplying telephonic communication with that person; whether they have claimed, in respect of coming under this condition, that the permissive powers to open streets in certain burghs within that area now hold good for the whole term of their license, and, further, that their license be extended from 1911 to 1913, so as to terminate at the same time as the license to the Corporation of Glasgow; whether the company have issued a print of an agreement with subscribers in the Glasgow area, dated June 18th, 1900, under which the intending subscriber must bind himself as a condition of receiving a connection from the company, not to subscribe to any exchange telephone system other than that of the company, or use at any of his premises any telephone instruments in connection with any such other system, and the company thus propose to give favour of preference to persons in the Glasgow district who do not join the Corporation Telephone Exchange as against those persons who do join that exchange; and what steps the Postmaster-General is prepared to take to secure that the company shall not obtain privileges under last year's Telegraphs Act, and at the same time refuse its obligations.

From a report in the *North British Daily Mail* it appears that Mr. Hanbury replied to these remarks as follows:—"The National Telephone Company have stated to the Postmaster General that they are willing that the conditions mentioned in the questions shall be made a condition of their license. They have also undertaken to prove to the satisfaction of the Postmaster-General that they have incurred, or contracted to incur, material expenditure in laying underground wires in certain burghs in the Glasgow area, and have acquired powers for the purpose under agreement with the local authorities. The Postmaster-General is not aware that the company have at present claimed that the powers given by their agreements with local authorities in the Glasgow area will hold good during the period of the license granted to the Corporation of Glasgow, and that their license will be extended for the full period of the Corporation license, but when conditions to be observed on the part of the company have been duly complied with, they will, no doubt, claim that they are entitled to the advantages specified in Section 3 of the Telegraph Act, 1890. The Postmaster-General's attention has been drawn to the form of the agreement now being offered by the company to their subscribers. There is some doubt whether the condition mentioned by the hon. member can be held to be a breach of the undertaking not to give preference to persons in the Glasgow area, but there is another condition in the agreement form—that as to giving wayleaves for the wires of other persons—which would unquestionably be a violation of the undertaking not to require any person to grant any facility except for the purpose of supplying telephonic communication to that person. Any breach of the new conditions which the company are to accept as conditions of their license will, when those conditions are legally in force, render the company liable to the same penalty as a breach of the original conditions—namely, the termination of their license.

The New trans-Atlantic Cable.—Reuter's New York agent says that on the morning of the 11th inst. the shore end of the German cable was laid from Coney Island. Ten miles had been buoyed. The *Anglia* was to pick up the line on Tuesday, and will continue laying the cable as far as the Azores.

A later New York despatch says that on 14th inst. the *Anglia* picked up the shore end of the German cable, and, after splicing it, proceeded to lay the main cable.

The Telegraph Wire Export Trade.—Although not so large as in June last, some very heavy shipments of telegraph wire and apparatus connected therewith, were made from this country during the past month. The returns just issued show that during July the exports of such material attained a value of £205,306, which compares with £395,809 in the preceding month, and only £97,635 in July, 1899. The activity which has ruled this year in this branch of trade is well indicated by the returns for the seven months ending with July. These show a total of £1,665,016, or an increase of no less than £1,065,708 over the first seven months of 1899.

The Telegraph Line to the Yukon.—The *British Columbia Review* says that the line from Atlin to Telegraph Creek having been completed for a distance of 205 miles, it is stated that the work had been extremely difficult owing to the density of forest and the general topography of the country penetrated. At the Ashcroft end the line has been completed to Hazelton, a distance of 300 miles—leaving a 500-mile span to be completed to join the extreme points. Large gangs of men are now working north and south towards each other, and it is believed connection will be made within two months. A branch line is also being laid from Stony Creek at the head of Stewart River to Manson Creek, where many valuable hydraulic properties are located. $12,000 has been appropriated by the Public Works Department for the construction of a branch line of 50 miles from Dawson to Fort Cudahy, on the borderline of Alaska. The United States Government will build, as a part of the United States signal service system, a cable from Nome to St. Michaels, and a landline from St. Michaels to connect at Cudahy with the Canadian system, thereby assuring direct wire connection to Nome.

(*Continued on page 267.*)

STOCKPORT ELECTRICITY WORKS.

Following the example of so many of their South Lancashire neighbours, the Corporation of Stockport in 1881 obtained a provisional order for the supply of electricity ; but it was not until November, 1896, that the Council decided to prosecute the matter with vigour. The Gas Committee was constituted the Electricity Committee also, and reports were obtained from Mr. Mountain, of Huddersfield, and Mr. J. N. Shoolbred, of London. Mr. Shoolbred's scheme was adopted, and the necessary borrowing powers obtained for a loan of £25,000 ; tenders were obtained, and the contracts were let on February 10th, 1898.

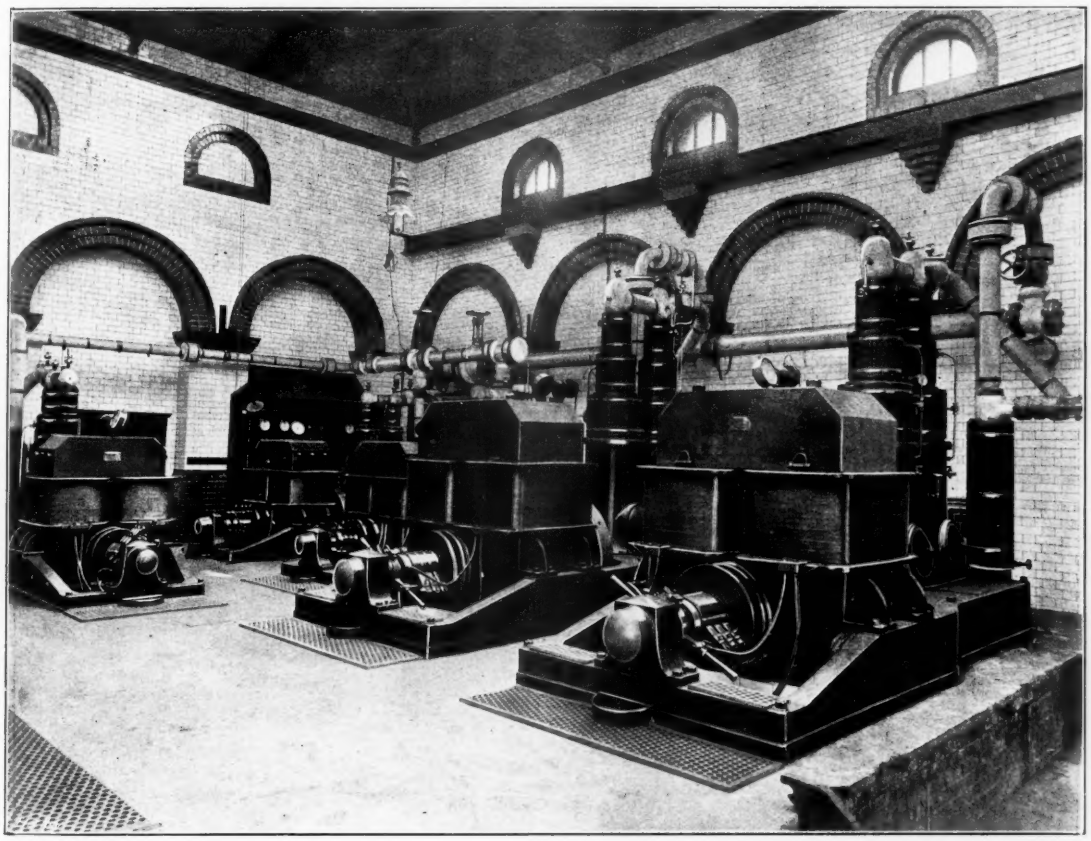
The supply of gas had been in the hands of the Council for 21 years, under the direction of Mr. S. Meunier, and with such marked success, that they resolved to entrust the kindred undertaking to his care also. As a rule, we do not favour the combination of the two functions, but we must judge by the results obtained, and in this instance we have pleasure in stating that the action of the Council has been entirely justified, as we shall show later on.

The Council selected a site for the station at Millgate, on the River Goit, and near the gasworks. Some difficulties connected with the foundations, due to the sloping ground, were successfully overcome, and substantial brick buildings were erected, comprising engine and boiler houses, battery room and test room.

There are at present two Lancashire boilers, 28 feet × 8 feet, supplied by Messrs. Tetlow Bros., of Hollinwood, and fitted with Wilton furnaces ; the latter were devised for burning coke breeze, the refuse of the gasworks, and are worthy of special mention. Their essential features consist of three cast-iron tubes resting on the bottom of the furnace, which act as fire-bars ; these are perforated with numerous small holes, and are fitted with steam jets, by means of which a strong air blast is forced through the fuel. Excellent combustion is obtained, and the clinker which forms is easily withdrawn ; moreover, while the tubes are inexpensive, they are also extremely durable. We saw some of these tubes at the gasworks which had been in constant use for five years without renewal, and they showed no signs of deterioration.

The boilers are worked at a pressure of 200 lbs. per square inch ; the fittings and stop valves are of Messrs. Hopkinson's make. There is at present no economiser, though provision has been made in the plans for this, as well as for condensing plant. The exhaust steam is passed through a Berryman feed-water heater.

The two feed pumps are of the Worthington type, and each is capable of supplying both boilers ; water is obtained from the town supply, and is stored in a large tank over the battery room.



General View of Engine Room.

The steam piping was carried out chiefly by Messrs. Crompton & Co., and consists of a ring in the boiler house, from which a single 12-inch main is taken into the engine room ; here it divides into a 5-inch pipe feeding the smaller sets, and a 7-inch pipe supplying the larger ones. The piping, which is of steel, is supported by slings from brackets, and is covered by magnesia.

A 6-ton crane by Messrs. Higginbottom & Mannock traverses the engine room.

The plant in the engine room consists of five generating sets, three of 56 kw. each and two of 140 kw. ; each of them consists of a McClure & Whitfield two-pole dynamo, driven by a Willans two-crank triple-expansion engine of the

usual type. The dynamos are all shunt-wound, and have drum bar armatures with evolute end connectors; the brushes are of copper gauze. The small units give out 224 amperes at 220—310 volts, 450 revolutions per minute. They are used on either side of the three-wire system, and are also able to charge the batteries without the aid of a booster. The large machines give 280 amperes at 460—500 volts, 350 revolutions per minute.

All the machines have given entire satisfaction, and run cool and without sparking, while they are capable of standing a 20 per cent. overload without injury. The large sets were run at half pressure for a time, before the three-wire system was completed, and gave no trouble from sparking. The dynamos are of massive build, as will be seen from our view of the engine room; the bearings are fitted with continuous ring lubrication.

The foundation within the bed-plate is faced with opalite tiles, which give a very clean and smart appearance to the machines.

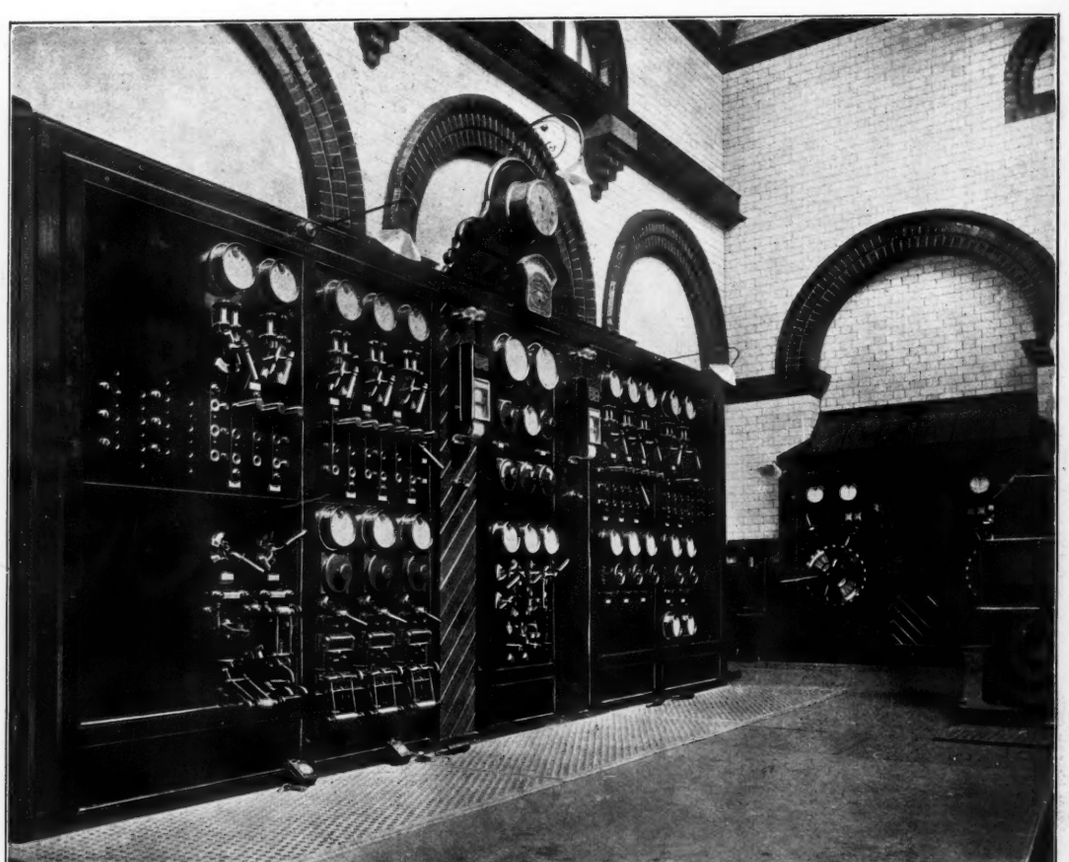
The centre panel carries an illuminated dial Weston voltmeter, which can be connected to any machine, five Crompton voltmeters and switches, an ammeter in the middle wire, and three double-pole throw-over switches for connecting the 230-volt sets on either side of the system.

The switchboard also carries two Elliott recording voltmeters and a station clock. The board was erected by the gasworks staff, and does credit to their skill.

A Kelvin watt-hour meter is in series with each machine, and a reversible Aron meter in each battery circuit.

The battery room is well lighted and ventilated; it contains two batteries of the Chloride type, 266 cells in all, each with 31 plates, in lead boxes. The storage capacity of the cells is 750 ampere-hours at a five-hour rate, or 400 amperes for one hour. The connections with the regulating switches consist of bare copper rod on insulators.

There are two separate battery switchboards, situated as near as possible to the corresponding cells; part of one of these is shown in our view of the main board.



Main and Battery Switchboards.

All the switchboards are of Messrs. Crompton & Co.'s manufacture. The main board is arranged on their usual three-wire plan; it consists of five panels of enamelled slate, finished off with pitch pine borders. The two left-hand panels carry the positive switch gear, with three horizontal bus bars and 10 vertical dynamo and feeder bars; there is space for four more vertical bars.

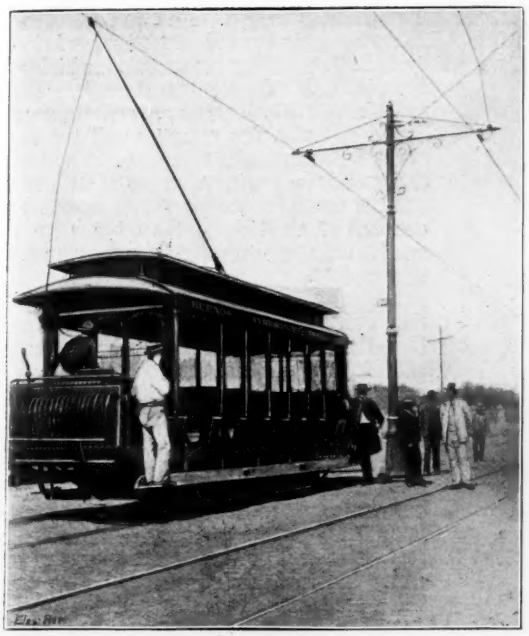
All the minimum cut-outs are mounted on these panels, and are interlocked with the field switches to prevent mistakes. The dynamos are protected by single fuses, and the feeders by duplex fuses. Feeder ammeters and dynamo voltmeters are also provided.

The two right-hand (negative) panels are similarly equipped, with the substitution of field rheostats for the cut-outs, and dynamo ammeters for the voltmeters. The resistances are wound on cast-iron tubes covered with asbestos.

Each board consists of two slate panels, each of which is equipped with a very large and massive double concentric regulating switch and duplex fuse, while one carries a voltmeter, and the other a reversible ammeter. Thus there are two regulating switches on each battery; one of these—the one connected with the middle wire—is used only to cut out cells, while the other is used in the ordinary way as a charge and discharge regulator.

The switches are operated by a double pawl and ratchet; by pressing one of two small levers up or down, a pawl is brought into gear with the corresponding ratchet, so that either or both of the concentric switches can be rotated either forwards or backwards, together or separately. The switch contacts alternate with dummy non-sparking contacts in the usual way; 20 cells are connected with each regulator.

The town is supplied on the three-wire system, at 230 volts. The cables are all of Messrs. W. T. Glover's single-wire "Diatrine" lead-covered type, except the last feeder put down; the feeders are laid on the solid system, the distributors are steel armoured and laid direct in the earth. The new feeder mentioned above is of Messrs. Henley's paper-



Buenos Aires.—Open Car.

insulated lead-covered type, 1 square inch section, laid in wooden troughs and embedded in bitumen.

The number of lamps connected in January last was equivalent to 7,700 of 8-c.p., more than half the capacity of the plant.

In addition to the private supply there are 36 Crompton arc lamps for street lighting. These are at present four in series between the 230-volt mains, but in future they are to run five in series. There is not much demand for power, though until lately a 60-h.p. motor was at work driving a "doubling" mill; the mill having changed hands, this supply is at present in abeyance.

Ferranti meters are used for the most part on consumers' premises. Up to this month the price of supply was 5d. per unit, with no meter rents, and the result for the first year of working (to March 31st) was a net profit of £118, after paying interest, depreciation, and sinking fund charges. This must be admitted to be an excellent result; indeed, it is claimed to be a record, under the conditions stated. The circumstances which have chiefly contributed to the commercial success of the undertaking are, no doubt, the economy of the joint management; the very low cost of the fuel used, which practically can be had for the cartage; and the low initial cost of the undertaking, which works out at £56 per kilowatt installed. The economy and convenience of the combination of gas and electricity undertakings, Mr. Meunier states, are most marked, not the least advantage being the possibility of drafting a large gang of workmen from the gasworks to assist in the completion of any urgent piece of work at short notice.

The Gas and Electricity Committee at a recent meeting, in view of the successful results already obtained, resolved to adopt a differential tariff, charging 5d. for the first hour's use per day of the maximum demand (estimated on the number of lamps installed), and 2½d. per unit afterwards. To reduce the rate for the summer quarters, the maximum demand during each of these is estimated at half that of either of the winter quarters.

The above method of introducing the differential system without alarming the consumers is worthy of imitation. Whereas the price was 5d. per unit all round before, it is now 5d. at first, and 2½d. afterwards, consequently no one can object that his bill will be *increased*. On the other hand, if the price had been altered to, say, 7d. and 2d., as has been done elsewhere, a number of the consumers would have been up in arms at once!

Future extensions of the station have been carefully provided for; two Babcock & Wilcox boilers are already on order, and the end of the engine room is closed with corrugated iron to admit of extending the building to accommodate additional generating plant. As a tramway scheme is already in hand, these additions will soon be required; it is not intended to modify the existing dynamos, but the traction sets will be arranged so as to be available for lighting also.

The Corporation has so far spent £25,000 out of an authorised loan of £48,000; a special loan will be necessary for the tramways. Evidently municipal enterprise is flourishing in Stockport!

In conclusion, we wish to express our thanks to Mr. Meunier and to his chief electrical assistant, Mr. Carter, for their kind assistance in the preparation of this article.

THE ELECTRIC LIGHTING AND TRAMWAYS OF BUENOS AIRES.

(*Concluded from page* 240.)

In a contract just signed, the Cia. General de Electricidad has agreed to supply the Anglo-Argentine Tramways Company, Limited, with power for their extensive system (106 kilometres of track), which is now being converted to electric traction. When completed, this will call for current for some 250—300 cars, entailing a large increase in the output of the station.

The Buenos Aires and Belgrano Tramway Company, which, as previously mentioned, is furnished with power by this station, owns tracks extending from the Plaza de Mayo in the centre of the city by two separate routes to the fashionable suburb of Belgrano. The one already completed, equipped, and in operation runs along the outskirts of the city, passing the racecourse, and around Belgrano; the other route is through the more central part of the city to the heart of Belgrano. Only the outer half is run elec-

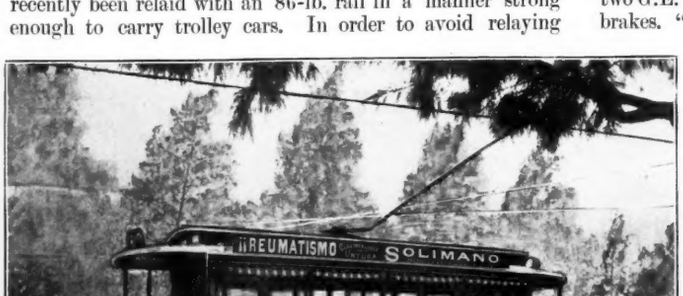
Pouring a Weld.

trically; the more difficult part of the line through the narrow streets is now being converted.

The lines operated electrically include 13 miles of double track, while 5 miles are still under construction. The rails weigh 86 lbs. per yard, and are 6⅝ inches high. The track is laid in three different ways, according to the paving of

the street through which it runs. Along the wood-paved streets of the centre, it is laid on a concrete base extending the whole width of the track. Towards the outskirts, where the paving is composed of granite setts, the rails sit on longitudinal concrete sleepers, and, lastly, in the suburbs, where there are macadamised roads, the track is laid on a native hard wood sleeper (*quebracho*) which rests on a foundation of broken stone.

A very large section of the horse-car track had but recently been relaid with an 86-lb. rail in a manner strong enough to carry trolley cars. In order to avoid relaying



Closed Car.

this track, the joints of all the rails were cast-welded on the Falk system; the cupola was carried on an iron wagon, the blower for the cupola being operated by a small steam engine, while the emery wheels for cleaning the ends of the rails before casting and for grinding the joints after casting were driven by portable oil engines. The cast-welded joints are also bonded with Chicago bonds around the weld, but with this exception Edison-Brown plastic bonds in conjunction with one Chicago bond have been used throughout the work, the two rails and both tracks being cross-bonded at intervals.

The distribution of the current is entirely underground, both feeders and distributors being paper insulated lead sheathed cables of the British Insulated Wire Company's manufacture, drawn into Doulton stoneware conduits. Negative feeders of the same make are also used, but these are armoured and laid direct in the ground.

Board of Trade regulations, although not obligatory, have been conformed with as regards drop in voltage on the track, and for this purpose two negative boosters driven by shunt wound motors have been installed in the station.

In order to facilitate the cutting out of sections, pillars have been placed on the edge of the pavement where feeders are connected to distributors. These pillars contain switches, fuses, lightning arresters and a telephone connected to a specially laid telephone cable, so that either the station or the car sheds can be rung up.

The pole construction is of a mixed description, depending on local conditions, and embraces the three usual forms of construction, because in some parts the track runs close to the edge of the pavement, in others it is in the middle of the street. Consequently there are centre poles with double arms, double poles with span wires, and side poles with single arms, and some with extension arms. The trolley wire is No. 00. In the narrow streets where the conversion is now being carried out, the method of suspending the trolley wire is by means of span wires, fastened to neat rosettes cemented into the walls of the houses. To avoid transmitting the vibration of the wire to the interior of the houses, the rosettes are furnished with a soft rubber cushion. A municipal ordinance has been passed giving the tramway company permission to erect poles right against the houses in case any of the owners object to the placing of the rosettes on the walls; this effectually disposes of further opposition!

There are 96 cars in all, of a varied character, consisting of double truck double-deckers with top roof, combination open and closed cars, open cars with reversible transverse seats, and trailers of the same type. All cars are fitted with two G.E. 1,000 motors, series parallel controllers, and electric brakes. "Providence" car fenders and electric headlights are also provided. The car bodies are by Jackson and Sharp, Brill, Stephenson, and Barney and Smith, and with few exceptions all trucks are of the Peckham extension pattern. The double-deckers have a seating capacity of 64 persons, and are useful for carrying large crowds from one end of the line to the other when this can be done with few stops; but owing to the time taken to get up speed, and stop, and for passengers to get down from the upper deck, they are hardly suitable for everyday traffic. Even then it is a question whether the smaller and higher speed cars cannot deal better with crowds such as are to be transported every Sunday and holiday to and from the race-course and Zoological Gardens. The management have recently decided to change all double-deck cars into single-deck cars. The convertible cars are arranged to have the sash and panel immediately below it pushed up into the roof, thus making them practically open cars, with doors at each end, and side steps. These are known as the Brill patented Brooklyn type. On the whole, this car is the most popular.

Messrs. Abella and Hayward are the resident engineers, while Mr. Forrest, of the B.I.W. Company, is in charge of the cable laying. The consulting engineers are Messrs. Kincaid, Waller & Manville. Mr. Lee H. Parker is their local engineer, under whose direction all the construction is being carried out.

Commercial Information Bureau at Paris.—The Paris Exhibition Royal Commission has instituted a commercial

Double Deck Car, with Roof.

information office for the use, without charge, of British exhibitors, visitors and members of congresses. They have placed at the disposal of English members who may be attending congresses, a spacious room where they can meet and discuss. This office is situated on the Quai d'Orsay; entrance by the side door on the east. A writing room is provided for the use of members of congresses, and information on trade matters will be given as far as possible. In the office will also be found a comprehensive set of Customs tariffs, information as to transport by land and sea, books of reference, directories, &c. Letters and telegrams can also during the Congress be addressed to members as follows:—Telegrams, care of "Britpav, Paris":—Letters, care of Commercial Information Office, British Royal Pavilion, Quai d'Orsay. The office will be open daily from 10 to 5 p.m.

TELEGRAPH AND TELEPHONE NOTES.

(*Continued from page* 262.)

Huddersfield and Municipal Telephones.—The important step by Huddersfield Corporation on Wednesday decided by 29 votes to 15 to apply to the Local Government Board for sanction to borrow £30,342 for telephone purposes for a period not exceeding 25 years, and that the plans, sections, and detailed estimates submitted by the borough electrical engineer be approved.

Manchester Telephones.—Mr. Gaine, manager of the National Telephone Company, appeared before the Telephones Special Committee of the Manchester Corporation on 7th inst., for purpose of further explaining the proposals of that company relative to the working of the telephone system in the Manchester area. At the close of the interview the Committee resolved to see representatives of the new Mutual Company, and also to obtain further information from Mr. A. R. Bennett.

Portsmouth Telephones.—The Finance Committee of the Town Council have reported that Mr. Bennett had attended and stated that his fee for a preliminary report as to a municipal telephone exchange at Portsmouth, which would enable the Committee to decide as to proceeding or not, would be 21 guineas and out-of-pocket expenses. It was decided to ask Mr. Bennett to prepare a report.

Telegraphic Interruptions and Repairs:—

Cables.	Interrupted.	Repaired.
South American:—		
Cayenne-Pinheiro	Oct. 11, 1899	
Pará-Maranham	March 1, 1900	
Ceará-Maranham	Feb. 20, 1900	
Iquique-Valparaiso	Aug. 2, 1900	
West Indies:—		
Mole St. Nicholas-Cape Haitien	March 6, 1900	
Latakia-Cyprus	June 20, 1899	
Tarifa-Tangier	Jan. 3, 1900	
Landlines:—		
Chinese:—		
Tientsin-Pekin	June 12, 1900	
Pekin-Kalgan	June 14, 1900	
Kalgan-Maimatchin	June 30, 1900	
Tientsin, *via* Shanghai	June 16, 1900	
Tientsin-Niuchwang	June 18, 1900	
South American:—		
Communications with all offices of Columbia beyond Buenaventura	January 22, 1900	
Ecuador landlines	March 13, 1897	
Landlines south of Macahé (Brazil)	April 25, 1900	
Landlines south of Serena	July 30, 1900	
Siberian:—		
Khabarowak-Wladiwostock	Aug. 11, 1900	Aug. 12, 1900
Communication "*via* Hanekine" interrupted on Persian territory	Feb. 24, 1900	
Saigon-Bangkok	Aug. 14, 1900	

CONTRACTS OPEN AND CLOSED.

OPEN.

Aberdeen.—August 25th. The Corporation invites tenders for steel poles, bases and brackets, for tramway equipment. See "Official Notices" August 10th.

Aberdeen.—August 28th. The Electric Lighting Committee wants tenders for a 12 months' supply of cables, meters, and house main fuse boxes. See "Official Notices" to-day.

Accrington.—The Corporation wants tenders for the supply of electricity meters. See "Official Notices" August 3rd.

Brussels.—September 19th. The Council of St. Jilles, lez Bruxelles, invites tenders for the installation and the commencement of supply upon a part of its territory. Conditions and plan for three francs at the office, No. 14, Parvis St. Jilles, St. Jilles.

Budapest.—October 15th. The Hungarian Minister of Commerce is prepared to receive tenders for the installation of two telephone exchanges, local and interurban, complete in all respects. See "Official Notices" August 3rd.

Cardiff.—August 31st. The Corporation wants tenders for sundry pipes, feed-water heater, &c., for the electricity works. See "Official Notices" to-day.

Cupar.—An electric light installation of about 800 lights is required for the Fife and Kinross District Lunatic Asylum. Application for particulars should be made to the Clerk of the Board, Cupar, Fife.

France.—August 23rd. Tenders are being invited until the 23rd inst. by the French Post and Telegraph authorities in Paris for the supply of 130 tons of copper or bronze wire. Tenders are to be sent to Le Sous-Secretarial d'Etat des Postes et des Telegraphes, 103, Rue de Grenelle, Paris, whence particulars may be obtained.

Fulham.—The Vestry wants tenders for electric wiring at the Town Hall, Walham Green. See "Official Notices" August 10th.

Germany.—August 30th.—The municipal authorities of Dusseldorf are inviting tenders until the 30th inst. for the supply and erection of two 3-ton overhead electric travelling cranes and two 4-ton ditto. Particulars may be obtained for 2s from, and tenders are to be sent to, Die Oberbürgermeister, Stadtbaumt III. Dusseldorf.

Germany.—September 10th.—The Hamburg Finance Deputation is inviting tenders for the supply and erection of two 30-ton electric cranes. Particulars may be obtained for 3s. from the Secretariat II. der Finanz Deputation (Rathhaus Ober-Erdgeschoss, Zimmer 429), and tenders marked 339 are to be sent to Die Finanz Deputation, Hamburg.

Grimsby.—August 18th. The Corporation wants tenders for the supply of a steam engine and dynamo, and extension of switchboard. See "Official Notices" August 10th.

Hackney.—September 12th. The Electric Lighting Committee is wanting tenders for the supply of condensing plant, cooling apparatus, pipe work and valves, feed pumps, switchboard and boosters, arc lamps, meters, crane and workshop equipment. See "Official Notices" to-day.

Halifax.—The Corporation wants tenders for the supply of incandescent lamps. See "Official Notices" August 3rd.

Hanley.—August 25th. The Electric Light Committee is inviting tenders for two Lancashire boilers, fuel economiser, smoke chimney exhaust fan, feed-water heater, forced draught fittings, coal conveyor and bunkers, also various accessorial plant and apparatus for the electricity works. Specifications, &c., from the borough engineer or the Corporation electrical engineer, for 5s.

Ilford.—August 29th. The District Council wants offers from firms willing to take up free wiring in the district. See "Official Notices" to-day.

Leeds.—The Corporation wants tenders for the purchase of second-hand machinery, at present in use in connection with the electric tramways. See "Official Notices" August 3rd.

London.—August 20th. The Central Electric Supply Company wants tenders for boilers and piping, and mechanical stokers. See "Official Notices" July 27th.

London County Council.—September 22nd. Tenders are wanted for boilers, engines, dynamos, &c., at the Horton Estate, Epsom, Surrey. See "Official Notices" August 10th.

Luton.—September 14th. The Town Council invites tenders for watt-hour and demand meters. See "Official Notices" August 3rd.

Madrid.—August 18th. Tenders are invited by the Spanish Government, not later than August 18th, for the concession of a system of electric tramway lines in Barcelona. Some particulars may be examined at the commercial department of the Foreign Office between 11 a.m. and 5 p.m.

Manchester.—August 25th. The Tramways Committee wants tenders for cast-iron bases for tramway poles. See "Official Notices" to-day.

Newcastle-on-Tyne.—August 22nd. The Corporation wants tenders for laying five miles of double-line tramway. See "Official Notices" August 3rd.

Newport (Mon.).—August 22nd. The Guardians want tenders for lighting the workhouse. See "Official Notices" August 10th.

Plumstead.—September 19th. The Vestry wants tenders for boilers, refuse destructor, steam fittings, economiser; steam piping, pumps, &c., &c.; steam generators—two 300-I.H.P.; two 150-I.H.P.; and one 100-I.H.P.; condensing plant, cooling tower, &c.; switchboard; battery; traveller; mains, meters, arc lamps and posts, &c. See "Official Notices" August 10th.

Portsmouth.—September 4th. The Corporation wants tenders for the complete equipment of the tramway power station. See "Official Notices" August 3rd.

Rochdale.—August 22nd. The Corporation is inviting tenders for the wiring of the Town Hall. See "Official Notices" to-day.

Roumania.—August 24th. Tenders are being invited until the 24th inst. by the Roumanian Post and Telegraph authorities in Bucharest for the supply of 40 tons of galvanised iron wire.

Salford.—September 3rd. The Corporation wants tenders for a lighting switchboard, traction ditto, and balancing transformers. See "Official Notices" August 10th.

Shipley (Yorks).—August 27th. The Council wants tenders for steam and exhaust pipes, battery, switchboard and connections, and cables for electricity works. See "Official Notices" to-day.

Spain.—August 24th. Tenders are being invited until the 24th inst. for the establishment and working of a telephone

exchange in the town of Ciudad Real. Particulars may be obtained from, and tenders are to be sent to, El Gobierno Civil de la Provincia de Ciudad Real, Spain.

Stockport.—August 31st. The Tramways Committee wants tenders for 20 double-deck tramcars with electrical equipments. See "Official Notices" July 13th.

Warrington.—The Corporation wants tenders for electric light installations in certain buildings. See "Official Notices" August 3rd.

Warsaw.—August 28th. The Secretary of State for Foreign Affairs has received a despatch from Her Majesty's Acting Consul-General at Warsaw stating that tenders are invited by the Russian Government, not later than the 28th prox., for the telephone service of Warsaw, St. Petersburg, Moscow, Odessa, and Riga. Some particulars may be examined at the Commercial Department of the Foreign Office between 11 a.m. and 5 p.m.

Whitby.—September 3rd. The Council wants tenders for the supply of two water-tube boilers, pumps, condensers, pipes, &c.; two steam dynamos, balancer, and boosters; switchboard and connections; battery; travelling crane; cables, arc lamps, &c. See "Official Notices" August 10th.

Worthing.—September 3rd. The Corporation wants tenders for three 96-KW. steam dynamos, two marine boilers, steam and other piping and condensing plant, manhole covers, arc lamps and posts, stoneware casings, cable work, battery, balancing transformers and motor-generators, economiser, and 5-ton traveller. See "Official Notices" to-day.

CLOSED.

Bermondsey.—The Vestry has accepted an amended tender of Messrs Todd & Co., for the erection of dust destructor and electric lighting buildings at £12,723.

Bradford.—The City Council has accepted tenders as follows for the extension of the Valley Road Electricity Works:—Messrs. S. Z. de Ferranti, Limited, for the supply and erection of a switchboard for a pressure of 500 volts for the sum of £3,069 16s.; Messrs. Babcock & Wilcox, Limited, for mild steel steam and feed piping and fittings, £1,069; Messrs. Cole, Marchent & Morley, Limited, for two steam engines, £15,141; Messrs. Ernest Newell and Co., for coal conveying apparatus and storage hopper, £1,070, and for ash conveying apparatus for £415; Messrs. Cole, Marchent and Morley, Limited, for a cooling tower, £2,633; the British Westinghouse Electric and Manufacturing Company, Limited, for two dynamos of 1,000 KW. capacity each, £9,108 10s.

Bradford.—At last Tuesday's meeting of the City Council the Tramways Committee recommended the acceptance of the tender of Messrs. V. Demerbe & Sons, of Belgium, for the supply and laying on their system, of the rails required for the proposed extensions to Farsley, Thackley, and Idle, Clayton, and Queensbury, and for the relaying of the Manchester Road line. The price is 17s. per yard of single track.

Brookwood Asylum.—Messrs. Shalders & Davis's (Southampton) tender of £5,600 for electric light plant and wiring at Brookwood Asylum has been accepted.

Glasgow.—Port Dundas station bus bar extension. Messrs. Mechan & Sons have secured this contract.

Huddersfield.—Messrs. R. W. Blackwell & Co., Limited, are to supply the overhead equipment for two miles odd of tramway for the Corporation.

Sutton Coldfield.—Messrs. Mechan & Sons have secured the switchboard contract for this electric lighting undertaking, subject to the Board of Trade granting powers.

Walsall.—The tender of Messrs. Thomas Parker, Limited, for supplying two transformers, including the necessary switch gear and booster required for the proposed extension of the electric main to the Pleck, for the sum of £1,440, has been accepted, conditionally. The tender of Messrs. Callender & Co., Limited, for laying the electric mains required has been accepted conditionally, their schedule of prices being as follows:—Two H.T. feeders, laid solid, 13s. 11d. per yard; two 6-core pilot wires, 2s. 9d. per yard each; L.T. distributor, ¼-inch section, 14s. per yard. The town clerk had been directed to inform the Local Government Board that almost the whole of the £15,000 proposed to be borrowed was for this one extension, the other portion being for pilots and feeders in other parts of the town.

NOTES.

Sunderland Electric Trams.—The official opening of the Sunderland Corporation Electric Tramways took place on Wednesday afternoon. Luncheon was served at the Town Hall at 1 p.m., and several cars laden with the visitors left for a run over the line.

The Sydenham Boiler Explosion.—This explosion is illustrated by four photographic reproductions in a contemporary, and affords a lesson in the weak part of the locomotive type boiler that exploded at the age of seven years. The immediate failure concerned the firebox; this apparently collapsed and was torn out of the casing. The reaction on the ground sent the boiler flying, and apparently left the top of the firebox with all its stout and rigid girder stays on the floor, just on the site of the firebox. Considering a firebox, say, 40 inches × 30 inches—a by no means large size—the area will be 1,200 square inches, and at 150 lbs. pressure the load will be 18,000 lbs. The circumference of this box will be 140 inches. If ½ an inch thick, its cross-section of material on the horizontal plane will be 70 inches. On each square inch of material disposed as a flat column, measuring 2 inches × ½ inch, there is thus a load of 130 lbs. If the firebox is 4 feet in height, some idea of this load can be obtained by placing it on the top of a 4 feet pillar of flat iron. Evidently the load is great. The flat roof of a firebox is immensely stiffened by numerous girder stays, and this flat roof is slung to the outer casing by sling stays so as to safeguard the sides. In the Sydenham boiler these roof slings have come away with the firebox crown, and the firebox appears to have crippled and torn away. As roof slings usually have slots in their pin holes to allow expansion, it is evident they are relied on as standby stays only, and that the load of steam is taken by the firebox sides acting as a column and transmitting the load to the bottom ring of rivets and to the stud stays—these latter very badly placed to receive transverse loading, though very effective, no doubt, in holding the plates against buckling. But it is this buckling stress that is the chief danger, and it is one to which least attention is usually paid. Steam users and engineers-in-charge should look well to this, and should also see to it that the roof slings are connected to the girder stays and to the casing in a sufficient manner. There appear to have been eight sling stays in the Sydenham boiler, which, we think, from the illustrations, must have been larger than our hypothetical firebox, so that each stay at the assumed pressure would carry over 20,000 lbs. if called on to act. There is a tendency to fasten such stays somewhat insecurely to the outer case. The fastenings are rivets, and a direct pull on the rivets is unlikely, while if pinned to crown ribs the ribs are apt to be easily torn away. These crown stays ought to be well pinned to thoroughly secured roof ribs, and these should be something more than ordinary angle or ⊥ bars. Insecure fastening of stays has been a common failing in boiler making, and at one time gusset stays would be attached to paltry single angle irons with nothing better than a bit of ¾ round iron put through the rivet holes and roughly bent by a blow from a hammer in order to prevent the pin pulling out. The contrast between the heavy girder stays of a locomotive type firebox and its safety or sling stays is often ridiculous.

Electric Power Scheme for the Western Highlands.—In view of the successful utilisation of the watershed of the Western Highlands for the generating of electric power at the Aluminium Works at the Falls of Foyers, says the *Financial Times*, it will cause no surprise to learn that another big scheme is in contemplation. The proposal under consideration is to trap the waters of Loch Ericht and convey them across country for a distance of 20 miles to the head of Loch Leven, where a waterfall of 110 feet would be obtained, giving a power equivalent to 23,000 H.P. The scheme, according to the estimate, will cost 1½ millions sterling. Another important enterprise on the tapis, is the establishment near the chief Scotch coalfields of central stations for generating electricity. The scheme, which will in due course be put before the public, provides for the supplying of electric power and lighting on economical lines, and as the large public works in Glasgow and the West of Scotland are freely adapting their machinery to electric propulsion, and as those behind the scheme are experts and have a good backing, there is every probability of its being carried through. Each station would distribute the current over a radius of 10 miles, and at less than one-half the present cost.

Municipal Profit Making.—The House of Lords Committee decided that, in the case of the Rochdale Corporation Tramways Bill, there should be no profits; or that any profits were to be applied to the reduction of fares. This course was pursued largely because the municipality contemplated working their lines outside as well as within the borough boundary, and clearly profits thus earned could not fairly be applied to the help of the borough ratepayers alone. This opens up a new phase of municipal trading, and one not, perhaps, quite to the liking of borough authorities. At the same time, we cannot but feel that it also opens a door for grave abuse. Either the tramways will be very badly managed, or some profit will accrue. It will go very much against the grain of the boroughs to provide tramway facilities for outsiders at a non-profitable fare, and rather than reduce fares, there will arise a tendency towards favouritism in the disposal of orders for tramway stores. The natural tendency in any borough will be to place such orders inside the borough. To this more or less legitimate desire will be superadded a tendency to the formation of a ring to control this supply, and secure orders at such enhanced prices beyond ruling rates as will serve to keep profits to *nil*, while not reducing fares, or what comes to much the same thing, stores will be lavishly used, and general slackness will prevail. We may even see the manager sacked for making a profit, and his successor driven to all kinds of stratagems to keep his place. He will not sleep o'nights fearing the profit bogey may dog his steps. The profit bogey at Rochdale may take the time-honoured place of the traditional "boggart" of Clegg Hall, which has, we fear, worn a bit thin in these modern times. But, joking apart, we think this phase is really serious; it shows the folly of municipal trading. There are some who may think we are hard on borough officials and municipal wrongdoers generally, but we would gently hint at the Salford Gas Scandal of not long ago, and even suggest a reminiscence of the Ratepayers' Association of Manchester, which discovered so very much about 1886, and we do not think municipal officials are still other than human. Municipal trading will begin a heap of troubles, and it will do immense harm to the general industry of the country and put a big check on tramway progress, for it will tend greatly to forbid continuous and liberal tramway schemes.

Electrical Cure for Tuberculosis.—Reuter's Paris representative states that at the International Congress of Medicine held at Paris, Dr. Labadi, delegate of the medical legal society of New York, Dr. Bertheau, of Paris, and Dr. Ducamp, of Bordeaux, have reported on a new treatment of tuberculosis discovered by a Frenchman—M. Francisque Croth. This discovery consists in the direct transmission of antiseptics by means of static electricity. The three physicians agree in affirming that a high percentage of patients treated by this method have been cured.

British Association.—The usual forecast notices have appeared in several London and Bradford newspapers regarding the probable papers for the Bradford meeting of the B.A. which opens on September 5th. It seems that the electrical papers will include one by Sir W. H. Preece on "The proposed Liverpool and Manchester Electric High Speed Railway;" Mr. A. H. Gibbings on "The Design and Location of Electric Generating Stations on a Large Scale for Supplying Large Districts;" Mr. Barker on "A Maximum Demand Meter;" Mr. J. G. W. Aldridge on "The Automobile for Electric Street Traction;" and Mr. J. B. C. Kershaw on "The Comparative Cost of Power Generation by the Steam Engine, Water Turbine, and Gas Engine."

Appointments Vacant.—The Leith Corporation want a chief clerk for the electricity works offices at £100 per annum. See "Official Notices" to-day.

A demonstrator is wanted to take charge of the laboratory classes in elementary electrical engineering and physical laboratory work at the Finsbury Technical College at £100 rising to £150 per annum. See "Official Notices" to-day.

Steam Traps.—Mr. Geo. T. Pardoe, of Harrow Road, W., writes to *Engineering* as follows:—"I was rather interested in the 'Tunley steam trap,' illustrated in your issue of July 27th, having had several of almost precisely similar design in use in a small electric lighting station I was recently in charge of in Italy, and when kept in proper repair they worked admirably. The outlet valve in that case was single beat, and the 'Tunley' in that respect would appear to be an improvement. The water inlet in the Italian make was part of the main casting of the body, and would, I think, be found to be an advantage in some respects, since the trap would not operate until a very considerable quantity of water had collected, when the trap would discharge it in one long blow instead of a number of shorter ones, since the discharge valve being small, when the water rises to the lip of the float the float sinks suddenly, and the water in the case flows over the lip faster than it is blown out, and when the float is ultimately cleared its lip rises well above the water line, thus giving a period of rest to the apparatus, together with an increasing force—buoyancy of float—holding the valve shut until the water reaches the designed height in the receiver. In the form you illustrate I should expect that a point of balance would be reached when the trap would operate more or less continuously. I may remark that in the form I had it was essential that a good joint was made between the valve stem and the float. One large trap gave some trouble by the nut shaking loose, until I had the spindle lightly riveted over after tightly screwing up the nut. I then had not the slightest trouble with them."

Honour to Whom Honour is Due.—The deep impression made by the Central London Railway on the excitable minds of a section of the daily press is perhaps to some extent excusable, having in view the undoubted importance of the new undertaking and the instant popularity which it has attained. With electrical engineers, however, the case is different. What electrician is not acquainted with the City and South London Railway?—the First Underground Electric Railway—the first built on the Greathead system, and equipped to the late Dr. Hopkinson's designs, with electric motive power, as long ago as 1890. Yet more than one of the orators at the Electrical Engineers' Dinner on Monday last ignored this wholly British line, which has been running successfully for 10 years, as well as the more recent Waterloo and City Railway, and the Liverpool Overhead Railway, and spoke of the Central London as a "new application" of electricity! It is indeed a new railway, but the application is not new. Again, one speaker described the line as the product of a combination of English financiers and American engineers. Surely this is a completely mistaken view of the matter. Although, to an electrician, the electrical plant is the most interesting and important item, the fact remains that it is a small matter compared with the immense labour and the engineering skill involved in the boring and lining of the 13 miles of tunnel. Moreover, while other means of propulsion than electricity were available (though none so good), it would have been impossible to dispense with the tunnels. We cannot speak for the financiers, but we do know that the Central London Railway was the work of British engineers; the luxurious cars were also built by British hands in British factories. The American share was confined to the magnificent power plant and line equipment. That English engineers could have carried out the last-named section is proved by the successful operation of the three other railways. Some people, however, are always on the lookout to decry their country's wares, and to bestow unmeasured praise abroad.

Visit of American Institute of Electrical Engineers.—On Sunday last about 55 members and guests (including many ladies) belonging to the British and American societies left Paddington at 10.5 a.m. for Henley, where electric launches were in waiting. In these the party were taken nearly to Shiplake, afterwards returning to Henley for lunch at the Red Lion. Earl Russell and Mr. C. H. Stearn joined the excursionists at Henley with their steam launches, and took some members of the party aboard.

At lunch, Prof. Perry, who presided, proposed the toasts

of "The Queen," and "The President of the U.S.A."; the toast of "Our Guests" was jointly proposed by Mr. Siemens and Mr. Mark Robinson, and responded to by Mr. Carl Hering and Mr. W. J. Hammer. This dual system of proposers in series was, as announced from the chair, worked out by the President (Prof. Perry), and was tried for the first time at this lunch. It is, therefore, presumably the subject of provisional protection. We might suggest as an improvement that the toast having been duly moved and seconded, the motion be put to the vote!

After lunch, the launches and lunchers proceeded to Maidenhead, partook of tea at the Thames Hotel, and returned by special saloon cars to Paddington. Thanks to the fine weather, the trip was in every way most enjoyable. On Monday morning the Electrical Standards Laboratory of the Board of Trade was visited, the party being received by Mr. Trotter, Mr. Rennie, and Mr. Crawley; as an alternative, some of the visitors were shown over the G.P.O. Telegraph Department by Mr. Gavey.

In the afternoon a visit was paid to the Central London Railway generating station and to the sub-station at Marble Arch, under the guidance of Mr. Cuningham and Mr. T. Stevens. Afterwards, proceeding by way of Bond Street station, which was specially opened for the occasion, the party went to the Davies Street station of the Westminster Electric Supply Corporation. In the evening a dinner was given in honour of the American visitors, which we deal with elsewhere.

On Tuesday an excursion was made to Chatham Dockyard, where the party was received by the Admiral Superintendent (Admiral Holland), and shown over the workshops and the first-class battleships *Albemarle* and *Irresistible* by the Civil Engineer. Next the visitors were taken over the electrical section of the School of Military Engineering by Major Carr, R.E., and were afterwards entertained at lunch by General Sir Thomas Fraser at the R.E. mess. Later on they attended a garden party at Lady Fraser's.

On Wednesday the British and American E.E. proceeded to the Paris Congress.

Among the principal American guests present at the various functions, were:—Mr. Carl Hering (President, Amer.I.E.E.), Dr. A. E. Kennelly, and Prof. Crocker (Past President, Amer.I.E.E.), Mr. E. O. Mailloux, Mr. W. J. Hammer, Mr. R. W. Pope (secretary, Amer.I.E.E.), and Messrs. H. Ward Leonard, H. D. McVay, J. G. White, W. C. Burton, D. Adamson, E. H. Mullin, L. A. Phillips, W. D. Brown, J. R. Edwards, B. J. Arnold, I. W. Henry, E. G. Bernard, R. O. Heinrich, W. J. Clarke, and R. W. Lohmann.

Electricity at the Dover Harbour Works.—We gather from the *Daily Mail* that electricity is now playing a leading part in the construction of the national harbour at Dover. The contractors have adopted the use of some new electrical machines, which have been found to expedite the work considerably. Among these machines are electrical mixers employed for making the huge 40-ton blocks used in the deep-sea work.

LEGAL.

Charing Cross and Strand Electricity Company *v.* Johnson and Another.

This case was in the list for hearing before Mr. Justice Cozens-Hardy in the Chancery Division on Thursday last week. Before the case was called on, Mr. Eve, Q.C., stated that this was a right of way case, but he could not ask his Lordship to try it on motion. No undertaking would be given, and the motion by consent would stand until the trial of the action.

NEW COMPANIES REGISTERED.

Halifax Room and Power Syndicate, Limited (66,792).—This company was registered on July 27th, with 20 members, each liable for £1 in the event of winding up, to supply power by means of steam, water, electricity, gas, oil, or otherwise, and to carry on the business of a room and power company, and of electrical and general engineers, textile manufacturers, builders, contractors, colliery proprietors, &c. The first subscribers (each with one share) are:—F. Ward, Elsinore, Halifax, dyer; W. Ward, Newstead, Halifax, dyer; W. Boothroyd, Lark Field, Brighouse, Yorks., drysalter; G. Tyson, Mayfield, Halifax, contractor; J. H. Harrison, Mayfield, Halifax, contractor; W. B. Ogden, 32, Holmes Terrace, Pellow, Halifax, clerk; and H. Marshall, Halifax, solicitor. The subscribers are to appoint the first directors.

Gardner Electric Drill and Hammer Company, Limited (66,796).—This company was registered on July 28th, with a capital of £40,000 in £1 shares, to acquire certain inventions and improvements relating to electric power rock drills and electric hammers, and to carry on the business of mine owners, mining and mechanical engineers, manufacturers, smelters, refiners, assayers, metallurgists, contractors, mineral and ore merchants, &c. The first subscribers (each with one share) are:—H. Clifton, 5, Malvern Villas, West End, Aldershot, clerk; L. Boorer, 35, Farley Road, Catford, clerk; A. E. Tester, 12, Ion Road, Thornton Heath, clerk; C. H. Syms, 103, Endelsham Road, Balham, S.W., clerk; Miss E. M. Roberts, 20, Alkham Road, Stoke Newington, N.; G. Sampson, 38, Gastien Road, Fulham, S.W., clerk; and C. W. Garland, 32, Old Jewry, E.C., clerk. The number of directors is not to be less than two nor more than five; the first are F. L. Gardner, A. Gaskell, and F. J. Roudebush; remuneration as fixed by the company.

Metropolitan Motor Manufacturing Company, Limited (66,800).—This company was registered on July 28th, with a capital of £10,000 in £1 shares, to adopt an agreement with A. E. Creese, P. Jackson and T. Underwood, for the acquisition of certain inventions relating to motor cars, and to carry on the business of motor car manufacturers, electricians, mechanical and general engineers, machinists, cycle manufacturers, agents and repairers, &c. The first subscribers are:—A. E. Creese, 58, Myddleton Street, Clerkenwell, E.C., engineer, with five shares; T. Underwood, 13, Colville Mansions, Talbot Road, Bayswater, W., gentleman, with five shares; G. Adams, 17, Philpot Lane, E.C., secretary, with one share; F. Jackson, 96, Southampton Row, W.C., gentleman, with five shares; A. Johnston, 109, Victoria Street, S.W., civil engineer, with five shares; Mrs. K. Underwood, 13, Colville Mansions, Talbot Road, Bayswater, W., with five shares; and A. Swinbourn, Mayville, Strafford Road, Twickenham, gentleman, with five shares. The number of directors is not to be less than three nor more than five. The first are A. Johnston, F. Jackson, T. Underwood, and another to be appointed by the subscribers; qualification, £250; remuneration, £25 each per annum (£50 for the chairman) and a share in the profits. Registered office, 68, Basinghall Street, E.C.

British Motor Traction Company, Limited (66,833).—This company was registered on August 1st, with a capital of £1,000,000 in £1 shares (500,000 preference), to adopt agreements (1) with the British Motor Company, Limited, (2) with H. J. Lawson and the British Motor Company, Limited, (3) with the British Motor Company, Limited, and J. Harris, and (4) with the British Motor Traction Company Limited, and S. F. Edge, to manufacture and deal in motors, cycles, velocipedes, vehicles, ships, boats, launches, flying machines, &c., and to carry on the business of mechanical and electrical engineers, &c. The first subscribers (each with one share) are:—T. T. Bradbury, 138, Gordon Road, Ealing, secretary; F. Kirkby, 20, Abchurch Lane, E.C., civil engineer; E. C. Parford, 55, Gurney Street, S.E., clerk; C. E. Osborn, Rensbury, Kingsfield, Walford, secretary; S. S. Ramskill, Waveney House, Ware Road, Herts, solicitor; J. Likeman, 50, Effingham Road, Hornsey, salesman; and H. L. Kohler, Aynho House, Lenthall Road, Dalston, clerk. The number of directors is not to be less than three nor more than seven; the first are to be appointed by the subscribers; qualification, 500 shares; remuneration, £100 each per annum, and £20 extra for the chairman.

British Electric Car Company, Limited (66,840).—This company was registered on August 2nd, with a capital of £50,000 in £1 shares, to adopt an agreement with A. K. Baylor, and to carry on the business of manufacturers of and dealers in rolling stock for tramways and light or ordinary railways, manufacturers of carriages, motor cars and vehicles and their component parts and accessories, &c. The first subscribers (each with one share) are:—A. K. Baylor, 18, St. Swithin's Lane, E.C., electrical engineer; G. J. Jackson, Times Buildings, New York, U.S.A., gentleman; W. M. Murphy, 39, Dame Street, Dublin, civil engineer; A. S. Tuffin, 128, Brixton Hill, S.W., clerk; E. Moss, 4, Rockhall Road, Cricklewood, N.W., gentleman; E. Beckett, 77A, Queen Victoria Street, E.C., railway engineer's representative; and E. T. Botwright, 81, Claremont Road, Forest Gate, accountant. The number of directors is not to be less than three nor more than five. A. K. Baylor is the first chairman; qualification, £200; remuneration as fixed by the company.

Northern Engineering Company, Limited (66,857).—This company was registered on August 2nd, with a capital of £30,000 in £1 shares, to acquire the business carried on at King's Cross, Halifax, by the Northern Engineering Company, Limited, to adopt an agreement with the said old company, and to carry on the business of machine tool makers, steam, gas and oil engine builders, electrical and mechanical engineers, &c. The first subscribers (each with one share) are:—H. C. Longsdon, Thorn Croft, Keighley, engineer; F. F. Greenroyd, Halifax, manufacturer; E. Fleming, 22, Highfield Terrace, engineer; S. Hey, Denholme, near Bradford, consulting engineer; G. A. Johnson, 43, Emily Street, Keighley, machine maker; R. Bailey, Whinborn, Keighley,

draughtsman; and W. W. Sunderland, 100, Cark Road, Keighley, wool comb maker. The number of directors is not to be less than three, nor more than five. The first are H. C. Longsdon, W. Partington, and S. Hey; qualification, 250 shares; remuneration as fixed by the company.

British Galvanic Metal Packing Company, Limited (4,598).—This company was registered in Edinburgh, on July 31st, with a capital of £36,000 in £10 shares, to make, sell, and deal in all kinds of packings, jointings, dynamo brushes, and articles of every description manufactured from galvanic metal paper. The first subscribers (each with one share) are:—W. Christie, 70, Wellington Street, Glasgow, merchant; J. Lumsden Catts, 87, West Regent Street, Glasgow, solicitor; Alfred Born, 19, Krasenstrasse, Berlin, solicitor; Dr. Gustav Tettenborn, 5, Schinkelplatz, Berlin, solicitor; Felix Graf von Bredow, 16, Kurfurstendam, Berlin, solicitor; Henry von Baensch, 225, Kurfurstendam, Charlottenberg, director; and Carl Endrnweit, 16, Dallrosser Strasse, Berlin, director. The number of directors is not to be less than three nor more than six; the first are William Christie, Henry von Baensch, Felix Count von Bredow, and Alfred Born; remuneration, 6 per cent. of the amount declared as dividend.

Priestman Brothers, Limited (66,920).—This company was registered on August 9th, with a capital of £13,000 in £1 shares, to acquire the business of Priestman Brothers, Limited (incorporated in 1889), and to carry on the business of electrical, hydraulic, heat, motive power, water supply and general engineers, electricians, founders, motor car, carriage and cycle manufacturers, machinists, tool makers, hardwaremen, &c. The first subscribers (each with one share) are:—J. Reckitt, Swanland Manor, Brough, East Yorkshire, Bart.; G. V. Maxted, Burnett Avenue, Hull, engineer; E. Hanger, Stoneferry, Hull, manufacturer; A. T. Watson, Leopold Street, Sheffield, chartered accountant; W. E. Backhouse, 106, Hanover Street, Sheffield, cashier; W. B. Esam, Bank Street, Sheffield, solicitor; and J. R. Whamond, 3, Crown Court, Old Broad Street, E.C., chartered accountant. The number of directors is not to be less than two nor more than six; the first are Sir James Reckitt, Bart., Isaac Milner, Charles Wardlow, George V. Maxted, Edward Hanger and John R. Whamond; qualification, £200; remuneration as fixed by the company.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Telegraph Manufacturing Company, Limited (58,158).—This company's annual return was filed on July 12th, when 20,000 preference and 20,000 ordinary shares were taken up out of a nominal capital of £300,000 in 40,000 preference and 20,000 ordinary shares of £5 each. £5 per share has been called up on 13,400 preference, and 13,400 ordinary shares, resulting in the receipt of £134,000. The remaining 6,600 preference, and 6,600 ordinary shares are considered as fully paid.

Calcutta Electric Supply Corporation, Limited (50,882).—This company's annual return was filed on June 8th, when 20,000 shares were taken up out of a nominal capital of £200,000 in 40,000 shares of £5 each; £5 per share has been called up, resulting in the receipt of £99,980; £20 remains in arrears. Notice of increase of capital to £300,000 was filed with the present return.

United River Plate Telephone Company, Limited (23,654).—This company's annual return was filed on August 2nd, when 40,000 preference and 58,000 ordinary shares were taken up out of a nominal capital of £500,000 in 40,000 preference and 60,000 ordinary shares of £5 each; £5 has been called up on each of 16,639 preference and 42,000 ordinary, and £2 on each of 23,361 preference shares, resulting in the receipt of £326,336 10s.; 16,000 ordinary shares are considered as fully paid.

SUPPLY STATION ACCOUNTS.

Halifax Corporation Electricity Accounts.

Last year when we dealt with the Halifax Corporation accounts of the electricity department, we were able to congratulate Mr. H. F. Street, the borough electrical engineer, upon having turned a net loss into a surplus, and the accounts recently issued, covering 1899, show that the surplus has been more than doubled, a most encouraging state of affairs. The anticipated savings in "raw material" have been rather discounted by the upward market tendency.

General Statement.

	1898.	1899.	Increase.
Total capital expenditure ...	£72,470	**£93,218**	£20,748
Number of units sold	628,759	**1,371,333**	742,574
Number of lamps connected ...	32,020	**45,403**	13,383
Gross revenue	£8,957	**£16,069**	£7,112
Gross profit	£4,565	**£9,001**	£4,436
Average price per unit sold ...	3·33d.	**2·77d.**	– ·56d.

The present tariff is 5d. per unit for lighting and 2½d. for other purposes, subject to a discount varying from 5 to 15 per cent., while the power supply to the tramways is charged at 2d. per unit. Motive power and other purposes apparently only brought in from private consumers a little over £30 in 1898, and £105 in 1899. The receipts were as follows for sale of energy:—

	1898.	1899.
Public lighting ...	£840	£1,027
Private supply ...	£5,538	£7,333 (including arrears)
Tramway supply...	£2,332	£7,459
	(279,867 units)	(895,024 units)

From the table it will be seen that the gross revenue from all sources has increased by £7,112, and that the gross profit after paying engineering and management costs has risen by £4,436. The following statement shows how the revenue is made up, and indicates that, notwithstanding the large gross increases, the revenue per unit has suffered on two items; the receipts per unit for sale of energy have fallen by a little over ½d. and the total receipts per unit by nearly ¾d.:—

Revenue Statement.

	1898. Gross.	1898. Per unit.	1899. Gross.	1899. Per unit.	Increase.
Sale of energy	£8,710	3·33d.	**£15,819**	2·77d.	– ·56d.
Meter rents, &c.	222	·08d.	**140**	·03d.	– ·05d.
Supply of lamps, fittings, &c.	...	...	**29**	·00d.	...
Sundry fees and rents received	25	·01d.	**81**	·01d.	·00d.
Gross revenue ...	£8,957	3·42d.	**£16,069**	2·81d.	– ·61d.

The cost sheet is exceptional in showing a reduction against every item, the most important economies being effected in "oil, waste, &c.," and "wages," which taken together amount to over ½d. per unit. The reduction of "works costs" by ½d. and of "total costs" by nearly ½d. must be regarded as exceedingly good, and Halifax with "total costs" of under 1½d. is a standing example of the benefit derived from a traction load.

Cost of Production.

	1898. Gross.	1898. Per unit.	1899. Gross.	1899. Per unit.	Increase.
Coal	£1,449	·55d.	£3,057	**·54d.**	– ·01d.
Oil, waste, water and engine room stores.	507	·20d.	596	**·10d.**	– ·10d.
Salaries and wages incurred in generation and distribution.	961	·37d.	1,147	**·20d.**	– ·17d.
Repairs and maintenance of buildings, engines, boilers, dynamos, &c.	247	·09d.	369	**·06d.**	– ·03d.
Works costs ...	£3,164	1·21d.	£5,169	**·90d.**	– ·31d.
Rent, rates and taxes ..	358	·14d.	770	**·14d.**	– ·00d.
Management expenses, salaries of managing engineer, secretary, clerks, &c.	367	·14d.	484	**·09d.**	– ·05d.
General establishment charges, stationery and printing, law charges and insurance	343	·13d.	476	**·08d.**	– ·05d.
Other expenses	159	·06d.	169	**·03d.**	– ·03d.
Total costs ...	£4,391	1·68d.	£7,068	**1·24d.**	– ·44d.

The balance brought down from the revenue account as gross profit amounts to £9,001. Interest on mortgage debt and monies due to bank, together with sinking fund charges absorb £3,512, leaving £5,489 as "profit." This was then transferred, £2,000 to the district fund, and £3,489 to the renewal account.

Profit Statement.

	1898.	1899.
Interest on loans	£1,893	£2,702
Sinking fund for repayments	810	810
Net profit carried to renewal account ..	1,862	3,489
" " " to credit of general rate	...	2,000
Gross profit	£4,565	£9,001

Bristol Corporation Electricity Accounts.

The accounts of the electricity undertaking of the Bristol Corporation again show a largely increased business. The increase in capital expenditure is not quite so much as in the previous year, but the additional output does not fall far short of what it was in 1898. The maximum load has, however, fallen according to the published figures. In 1899 a special power supply system was commenced on a three-wire direct current network at 500 volts on the outers, which is restricted to such portions of the city as may be likely to develop a good demand for motive power. The private supply is still given on the high pressure alternating system, with sub-stations and a 210-volt three-wire low tension network, while the

public lighting, comprising 308 arc and three incandescents, is—so far as the arcs are concerned—worked on the direct current multiple-series system at 600 volts. The 600-volt steam dynamos may be used either for the arc lighting or on the power mains. At the end of the year there were 32 motors, aggregating 111 H.P. connected to the mains. The general position of the undertaking is shown by the following figures :—

General Statement.

	1898.	1899.	Increase.
Total capital expenditure ...	£192,653	**£252,588**	£59,935
Number of units sold	1,362,786	**1,812,511**	449,725
No. of 30-watt lamps connected...	73,630	**91,117**	17,487
Maximum load in KW.	1,707	**1,676**	−31
Gross revenue	£26,112	**£31,857**	£5,745
Gross profit	£12,631	**£13,775**	£1,144
Average price per unit sold ...	4·24d.	**3·81d.**	−·43d.

The number of consumers was 1,215, being an increase of 248 during the year under review. The revenue has been affected by the reduction of the charges which came into force for private supply on October 1st, 1898, and for public lighting at the beginning of 1899.

The charges now are—for private supply, 5d. and 2½d., and for power, 1½d. and 1¼d., while the average price received for private supply alone was 4·18d., and for public lighting units, 1·725d. The load factor in Bristol is now 12·35 per cent, whereas in the previous year it was only 9·11 per cent. The reduction in rates of charge has caused the receipts from sale of energy to fall over ¾d.

Revenue Statement.

	1898. Gross.	1898. Per unit.	1899. Gross.	1899. Per unit.	Increase.
Sale of energy	£24,071	4·24d.	£28,800	3·81d.	−·43d.
Meter rents, &c.	881	·16d.	1,118	·15d.	−·01d.
Sales of lamps and old material, rental of motors, charging batteries, work on consumers' premises, and attendance public lamps.	1,018	·18d.	1,719	·23d.	+·05d.
Sundry fees, rents received, and premiums.	142	·02d.	220	·03d.	+·01d.
Gross revenue ...	£26,112	4·60d.	£31,857	4·22d.	−·38d.

The costs remain at practically the same figures as in 1898. Coal again shows a slight fall, and this indicates additional economy in working as the actual price paid per ton was higher, and it will be remembered that also in 1898 the price was some 15 per cent. above 1897. The "management salaries" are now debited with the remuneration of some members of the staff engaged almost wholly on "capital work," and this will swell the accounts of future years. By eliminating the charges for street lighting, and by crediting sundry sales to the various heads included under "repairs," Mr. Faraday Proctor gives the works cost for 1898 and 1899 as 1·56d. and 1·50d., and the total costs as 2·21d. and 2·18d. respectively. In the figures below all charges appearing in the accounts are taken into consideration, and all sales are treated as a source of revenue, which undoubtedly they are.

Cost of Production.

	1898. Gross.	1898. Per unit.	1899. Gross.	1899. Per unit.	Increase.
Coal	£4,901	·86d.	£6,231	**·83d.**	−·03d.
Oil, waste, water and engine room stores including carbons, &c., for street lamps.	676	·12d.	845	**·11d.**	−·01d.
Salaries and wages incurred in generation and distribution and attending public lamps	2,858	·50d.	3,824	**·51d.**	+·01d.
Repairs and maintenance of buildings, engines, boilers, dynamos, &c.	1,363	·24d.	1,958	**·25d.**	+·01d.
Works cost ...	£9,798	1·72d.	£12,858	**1·70d.**	−·02d.
Rent, rates and taxes ..	1,362	·24d.	1,767	**·23d.**	−·01d.
Management expenses, salaries of managing engineer, secretary, clerks, &c.	1,477	·26d.	1,999	**·27d.**	+·01d.
General establishment charges, stationary and printing, law charges and insurance.	575	·10d.	1,187	**·16d.**	+·06d.
Other expenses, gratuities, compensation, purchase of lamps for sale, interest on deposits, electric inspector's salary, &c., and special testing.	269	·05d.	271	**·04d.**	−·01d.
Total cost ...	£13,481	2·37d.	£18,082	**2·40d**	+·03d.

The depreciation account now stands at £2,025 and the reserve fund at £5,000. Half the sum received as rental of motors has been placed to the credit of the depreciation account. As will be seen, the conjunction of reduced charges for energy, slightly increased costs and augmented interest and sinking fund payments have led to only £146 being left over to be carried forward. Although this is the smallest surplus for the last five years, it cannot be said that the business is not in a thoroughly sound condition. In the case of a company's undertaking the whole of the £13,775 would be reckoned as "profit upon trading," and would, if thought fit, be divisible. Too much importance is often paid to net profit and too little to the other financial details presented by accounts.

Profit Statement.

	1898.	1899.
Interest on loans	£4,407	£6,020
Sinking fund for repayments	6,400	7,590
Net profit carried to depreciation account	912	19
Net profit carried to reserve fund	912	...
Net profit carried forward	...	146
Gross profit	£12,631	£13,775

CITY NOTES.

Waterloo and City Railway Company.

The thirteenth half-yearly general meeting of the shareholders of the Waterloo and City Railway Company was held on Thursday of last week at Waterloo Station, Mr. Wyndham S. Portal (the chairman) presiding.

The Chairman, in proposing the adoption of the report, said that at the end of last June £589,073 had been expended on capital account, and that included £15,416 expended in the half-year under review. On construction of way and stations, including engineering, the expenditure had amounted to £10,000, and on electrical equipment to £4,493. The estimate expenditure on capital for the current half-year was £15,000, and then they had another £10,000 estimated expenditure on capital in subsequent half-years, making a total of £25,000, and they hoped that even all that would not be required. But to meet that they had £122,000 available balance of borrowing powers. Turning to the revenue account, they would see that during the past half-year the gross receipts, after deducting the Government duty, had been £14,069 against £13,000 odd in June, 1899. The expenses at 55 per cent. amounted to £7,773 as against £6,640 in June, 1899, and the difference between the receipts and expenditure not being equal to pay the dividend of 3 per cent., they went to the London and South-Western Railway Company under the agreement of March, 1894, and they made up the deficiency of £2,375. After providing £359 for general charges, they carried £8,385 to the credit of the net revenue account, and after providing the interest on the debenture stock and a rent charge of £387 paid to the London and South-Western Railway, they had a balance available for dividend of £8,165. They proposed the 3 per cent. dividend, which would absorb £8,100, and leave them with a balance of £65 to be carried forward. The number of passengers carried during the past six months, exclusive of season ticket holders, was 1,868,737, as compared with 1,715,800 during the half-year ending June, 1899, showing an increase of 152,912. There had also been a marked increase in the number of season ticket holders—911 against 747 in the corresponding half of 1899. During the same period the traffic receipts were £14,070 as against £12,800, an increase of £1,255. Ever since its opening the line has shown a satisfactory increase both in passengers and in receipts, thus for the half-year ending December, 1898, the passengers numbered 1,442,855 and the receipts amounted to £10,888, while in the half-year under review the passengers, as he had before mentioned, numbered 1,868,737 and the receipts totalled £14,070, and they had every confidence in believing that that progress would be continued in the future. The working company in April last began to run single cars of a new pattern during the slack hours in the midday, and that had seemed to prove a great success. With the opening of the Central London Railway their two lines were brought into close contact with each other at the Mansion House, and he hoped that the opening of the Central London Railway would be mutually advantageous to both companies. It seemed as though the Central London Railway was going to be a big success, and on behalf of the board and the shareholders of the Waterloo and City Railway he offered their hearty congratulations to the proprietors of the Central London Railway on the successful completion of their undertaking. He was pleased to say that the returns which they had daily of the receipts, showed steady progress, and the last returns to hand, viz., those of last week, showed a considerable increase over any preceding returns.

The Hon. H. W. Campbell seconded the resolution, which was agreed to after a short discussion.

W. T. Henley's Telegraph Works Company, Limited.

An extraordinary general meeting of the shareholders of this company was held on Thursday last week at the Cannon Street Hotel. Mr. Sydney Gedge, M.P., presiding, for the purpose of considering, and if thought fit, passing resolutions for increasing the capital of the company.

The Chairman said the reason more capital was required was because the business of the company had increased so much as to render it absolutely necessary to have more money. He might add that there was a possibility of the company obtaining the contract for one of the three sections of the Pacific cable, for which the

Government was inviting tenders. Their estimate would be made up on the morrow, and if the tender of the company should be accepted, they would have the happiness of being one of the three contractors for the great enterprise, and in that case they would need all the money they could get. They were asking for the power to issue £50,000 in new ordinary shares, and £50,000 in new preference shares of £5 each, and the directors had not yet made up their minds at what price they would offer them to the shareholders. Following the precedent of the issue of new capital, he thought they might take it for granted that the price would give a good return to the ordinary shareholders. Assuming that the price would be £10 per share, the value on the Stock Exchange being about £13 to £14, the ordinary shareholders would be getting a bonus of £3 or £4, which was a good inducement for the shareholders to come forward and assist their co-partners in that very thriving concern. The first issue, as far as he could see, would be £25,000 of the £50,000 of the ordinary shares, and the same amount of the preference shares. On the calculation of them being taken up at £10, it would give to the company £50,000 on the ordinary capital, and £50,000 on the preference capital, which they hoped would be all that was necessary, unless the company got one of the contracts for the Pacific cable, in which event they would have to issue the remaining shares. When they had that additional capital they would be able to carry on the company's work without the restrictions which at present tied their hands. The business had steadily increased for several years past, at the least of 100 per cent. every three years. That was to say, the business was 30 per cent. more than it was last year, and that it was doubling itself every three years. They would understand the company could not go on increasing its operations without additional capital, which was wanted to pay increased wages and to erect new plant, and he trusted the experience of the past would teach them to rely upon the directors not to increase the capital account unless they thought it absolutely necessary. He concluded by moving the following resolutions:—

1. That the ordinary share capital of the company be increased from £150,000 to £200,000 by the creation of 10,000 additional ordinary shares of £5 each, such shares to rank in all respects *pari passu* with the existing ordinary shares. Except that dividend shall only be calculated and paid in respect of the amount from time to time paid up thereon. (2) That the board be and are hereby authorised to offer the said 10,000 new ordinary shares to the holders of the existing ordinary shares *pro ratâ*, according to the number of such shares held by them respectively, at such dates, at such price, and on such terms, as the board shall determine, and that the board be and are hereby authorised to dispose of any of such new ordinary shares which shall not be applied for in accordance with such offer, at such dates, at such price, and on such terms as they shall think most beneficial to the company. (3) That the preference share capital of the company be increased from £150,000 to £200,000 by the creation of 10,000 additional preference shares of £5 each, such shares to rank in all respects *pari passu* with the existing preference shares, except that dividend shall only be calculated and paid in respect of the amount from time to time paid up thereon. (4) That the board be and are hereby authorised to offer the said 10,000 new preference shares to the holders of the existing preference shares, *pro ratâ*, according to the number of such shares held by them respectively, at such dates, at such price, and on such terms, as the board shall determine, and that the board be and are hereby authorised to dispose of any of such new preference shares which shall not be applied for in accordance with such offer, at such dates, at such price, and on such terms as they shall think most beneficial to the company, but it is hereby expressly provided that the board shall not at any time issue preference shares to an amount exceeding the amount of ordinary shares for the time being issued.

These were unanimously agreed to.

Afterwards separate meetings of the ordinary and preference shareholders were held, sanctioning the passing of the resolutions, which were agreed to.

Blackpool and Fleetwood Tramroad Company.

The report of the directors for the last half-year, to be submitted at the meeting to be held in Fleetwood on 23rd inst., states that, including the sum brought forward, the balance of profit, after providing for debenture interest, is £4,265, and the directors recommend a dividend at the rate of £4 per cent. per annum, which will absorb £3,000, writing off £101 from the cost of application to Parliament for further powers under Act, 1898, £169 from preliminary expenses, and a sum of £500 for depreciation, leaving £495 to be carried forward. The number of passengers carried during the half-year was 660,006. The gross receipts were £10,126. Owing to the fact that the early part of the year was unfavourable for traffic and the season three weeks later than that of 1899, the number of passengers carried and the gross earnings are considered satisfactory.

Chili Telephone Company.

The annual meeting of this company, held at Winchester House last Friday, was presided over by Mr. George Keith, who, in moving the adoption of the report, said that they met under better circumstances than last year, their business in Chili having improved very considerably. The gross revenue for the year had increased $51,442, and the total expenses had been reduced by $10,681. The decrease in the expenses was certainly very satisfactory, more especially as the first half of the year had not been favourable for economical working. Unprecedented storms and inundations which took place in Chili last winter (the English summer), did great damage all over the country. The maintenance of the company's service was made both difficult and expensive. The decrease now shown in the expenses was effected during the second half of the year, and was accompanied by a large increase of revenue. The exchange was favourable, the mean rate for the previous year being 14¼, and for the past year, 15¼. With those improvements the income in Chili amounted to £18,180, an increase for the year of £4,764. The London expenses and charges remained practically unaltered with the exception of the item in connection with the debenture issue. The bonds falling due on March 31st last year, were renewed on the same terms and conditions for five years until March 31st, 1904. The debenture issue remained unaltered at £56,000, and there was no alteration in the interest payable. The result of the year's business was that after deducting all expenses and charges, and adding transfer fees, and the amount brought forward, there was a credit balance of £12,347. £4,000 of that had been placed to reserve, and the 4 per cent. dividend would absorb £8,800, £1,003 being carried forward. All things considered the result was very satisfactory. Much uncertainty existed during the year as to whether Chili would issue more paper money and give up the metallic conversion of the currency, the suspension of which was brought about by the monetary crisis of 1898. That had the effect of keeping down the exchange at which the profits of the year were remitted. Towards the end of the year the situation improved, as Chili was adhering to a sound money policy. The exchange in Chili had lately been firm and now stands at 17¼d., and the sterling profits are now much better than last year. £1,798 had been expended in the erection and equipment of new lines. Some considerable alterations had now become necessary to improve the efficiency of the service at Santiago, which would increase their expenditure for some time to come. Otherwise the plant was in good order and required no exceptional expenditure. A change had been made during the year in the management at Chili The former manager resigned, and Mr. Antonio Huneeus, who had acted for them at Santiago, had since been their adviser. So far as the present year had gone it was showing very good results.

The report was adopted and the dividend resolutions passed.

Mr. Keith was re-elected a director, and the auditors were also re-elected.

Liverpool Overhead Railway Company.

The half-yearly meeting of this company was held at Liverpool on Tuesday, Sir William B. Forwood presiding.

The Chairman, in moving the adoption of the report, said he believed it would be satisfactory to all the shareholders. The Overhead Railway Company had now been in operation for seven years, and they had steadily built up their own prosperity, until, he thought, they were now upon a permanent basis. They had done a great deal for the trade of the port in giving increased facilities for moving about the docks and in removing the congestion of the streets. Some idea of the work they had done might be gathered from the fact that they had carried on the line 58 million passengers, and their trains had run nearly five million miles, and that without any serious accident. Referring to the revenue account, he said they had earned during the past half-year £38,124, against £36,492 in the corresponding half of last year, being an increase of £1,530. Their expenditure had been £25,113, against £24,924, an increase of £189 only. These figures, he thought, would be satisfactory. The proportion of expenditure to revenue was 61·71 per cent., against 64·44 per cent. in the corresponding half of last year. They carried forward to net revenue account £12,909, which, with the balance from the previous account, made a total of £17,602 to be dealt with. The interest on mortgage debentures absorbed £3,400, leaving available for dividend £14,402, out of which they proposed to pay 5 per cent. on the preference shares, and an increased dividend at the rate of 3 per cent. per annum upon the ordinary shares, leaving a balance to carry forward of £4,452, against last year's balance of £4,320. He thought he might congratulate them upon being one of the three railway companies of this country able so far to pay an increased dividend in the past half-year. They had carried an increased sum to the reserve fund for the renewal of boilers and machinery at the generating station, permanent way, &c. They were anxious to build up that fund to a satisfactory point, and had now the substantial sum of £16,200 to the credit of it. Their expenses had been increased a little by the greater mileage run. The increased cost of coal they had not felt owing to their having a large contract, but during the present half-year that would tell, as they were paying now more than double the price under the old contract. He did not think, however, that the high price of coal would continue long, as there were now signs of a slump setting in. The railway still held the record for punctuality, 97·3 per cent. of the trains during the half-year having been run on time. The electric tramway system they had taken over had been opened as far as Waterloo, and the result was quite satisfactory, both as regards the local traffic and as a feeder for the overhead railway. It would be still further extended towards the end of next month. The Bill they had had in Parliament had received the Royal assent, but they had eliminated from it the power they sought to increase the size of the Pierhead Station, as the Corporation of Liverpool had opposed that clause. The object was to introduce at no distant date a 2½ minutes' service of trains between the Pierhead and the north end, which would almost have given that part of the system a movable platform, and given great facility to the trade of the port. The batteries they were providing for the purpose of meeting the wants of the service were now nearly complete, and he hoped that next winter the trains would be thoroughly well lighted. Their new train would be delivered this month, which would enable them to make the journey from end to end of the line in 20 minutes, including stoppages, instead of 35 minutes as at present. That would be a great boon to traders, and also an economy in working. They were also considering proposals to work a mineral traffic during the night time, the lines being now practically idle for eight hours during the night. If that were done it would be to the advantage of the shareholders.

Mr. John Brancher seconded the motion, which was carried unanimously, without comment.

The Chairman next moved the payment of a dividend on the preference shares at the rate of 5 per cent. per annum, and at the rate of 3 per cent. per annum on the ordinary shares, for the past six months.

Mr. Brancher seconded, and this was also carried unanimously.

This was all the business, and the Chairman, in acknowledging a vote of thanks to himself and the other directors, said they had in Mr. Cottrell, the engineer and manager, an exceedingly valuable official, who gave the board great assistance in the working of the railway.

Stock Exchange Notices.—Application has been made to the Committee to allow the following to be quoted in the Official List: Edmundson's Electricity Corporation, Limited.—Further issue of 9,400 ordinary shares of £5 each. The Committee has appointed Wednesday, August 29th, a special settling day in Babcock & Wilcox, Limited—Further issue of 90,000 ordinary shares of £1 each, fully paid, Nos. 440,001 to 530,000, and has also granted same an official quotation.

British Columbia Electric Railway Company.—A meeting of this company was held at 1 and 2, Gt. Winchester Street, E.C., on Friday last for the purpose of confirming a resolution altering the articles of association.

Imperial Tramways Company, Limited.—Warrants have been posted to shareholders in payment of an interim dividend at the rate of 7½ per cent. per annum on the ordinary shares for the half-year ended June 30th last.

Castner-Kellner Alkali Company.—An extraordinary general meeting will be held on the 23rd inst. to confirm the resolution recently passed for the purchase of the Aluminium Company's undertaking.

Charing Cross and Strand Electricity Supply Corporation.—The letters of allotment of the new issue of 30,000 new preference shares have been posted to the shareholders.

TRAFFIC RECEIPTS.

The Blackpool and Fleetwood Tramroad Company.—The receipts for the week ending August 11th, 1900, were £1,904 7s. 7d.; receipts for corresponding period, 1899, £2,167 18s. 5d.; aggregate for half-year to date, £7,787 8s. 1d.; aggregate corresponding period of last half-year, £7,981 4s. 0d.

The Bristol Tramways and Carriage Company.—The receipts for the week ending August 10th, 1900, were £4,061 7s. 5d.; corresponding period, 1899, £4,489 1s. 5d.; decrease, £427 14s. 0d.

The Central London Railway.—The receipts for the week ending August 11th, 1900, were £5,042; previous week, £4,323; increase, £719. Total receipts (2 weeks), £9,365. Miles open, 6.

The City and South London Railway Company.—The receipts for the week ending August 12th, 1900, £1,555; August 13th, 1899, £1,033; increase, £522. Total receipts for half-year, 1900, to date, £9,001; corresponding period, 1899, £5,687; increase, £3,314. Miles open, 1900, 4¾; 1899, 3¾.

The Cork Electric Tramways and Lighting Company.—The receipts for the week ending Thursday, August 9th, 1900, were £521 9s. 4d.; corresponding week last year, £545 10s. 10d.; decrease, £24 1s. 6d. Total to August 9th, 1900, £12,662 3s. 11d.; corresponding period last year, £11,464 5s. 9d.; increase, £1,197 18s. 2d.

The Dover Corporation Tramways.—The receipts for the week ending August 11th, 1900, were £316 18s. 10½d.; August 12th, 1899, £334 5s. 3d.; decrease, £17 6s. 4½d. Total receipts to date, 1900, £6,156 3s. 10½d.; corresponding period, 1899, £5,819 10s. 10d.; increase, £336 13s. 0½d. Miles of track open, 1900, 8; 1899, 3. Car miles run, 1900, 5,201; 1899, 4,667. Number of cars, 1900, 11; 1899, 11.

The Dublin United Tramways Company.—The receipts for the week ending Friday, August 10th, 1900, were as follows:—D. U. T. Co., horse cars, £28 8s. 6d.; ditto, electric cars, £3,729 7s. 5d.; D. S. D. Co., electric cars, £999 1s. 6d.; total, £4,756 17s. 5d; corresponding week last year—D. U. T. Co., horse cars, £2,274 3s. 6d.; ditto, electric cars, £1,353 9s. 6d.; D. S. D. Co., electric cars, £1,284 5s. 8d.; total, £4,911 18s. 8d.; increase, £155 1s. 3d.; aggregate to date, £29,944 16s. 4d.; aggregate to date last year, £27,139 6s. 4d.; increase to date, £2,205 10s. 0d. The mileage worked is 43 miles electrically, 1 mile by horses, as against 18 miles electrically, 26 miles by horses, for the corresponding period last year.

The Halifax Corporation Tramways.—The receipts for the week ending August 12th, 1900, were £914; corresponding period, 1899, £886; increase, £28. Total receipts to date, 1900, £14,859; corresponding period, 1899, £11,447; increase, £3,412. Miles of track open, 1900, 14; 1899, 6½. Number of cars, 1900, 28; 1899, 14.

The Liverpool Overhead Railway Company.—The receipts for the week ending August 12th, 1900, were £1,876; corresponding week last year, £2,074; decrease, £198. Total traffics from July 1st, 1900, £10,375; ditto corresponding period 1899, £10,067; increase, £308. Miles open 6·57 chains.

STOCKS AND SHARES.

Wednesday Evening.

Although business in the Stock Exchange is declared each day to sink to the very lowest point on record, markets are very hard. The sagging away that is the usual concomitant to idle days is noticeable only by its absence. A glance at our price lists shows how little affected quotations are by the small amount of support rendered to the investment departments of the House. Of the 120 securities whose prices we give, less than 10 exhibit any change, except those produced by the supply shares being marked "ex dividend." The other fluctuations which have occurred are the result of not more than a score of bargains. Only in one solitary case has the change exceeded 10s., the one exception being a rise of £1 in National Telephone first Preference shares, in which the market is so limited that the appearance of a possible buyer is hailed with an immediate advance in the price of the shares.

In the electrical supply section the principal interest is at present centred upon Metropolitan shares. The Vestry of Marylebone has, we understand, gone so far as to actually affix its seals to the agreement between itself and the Metropolitan Electric Supply Company, whereby part of the company's undertaking is to be acquired by the Vestry. But this agreement is liable to be upset by the new Council which comes into office in Marylebone some three months hence. Until that body ratifies the arrangements now made, it is not likely that a move will be decided upon by either party, and there the matter remains for the present. Whatever the Council may do when it assumes office, it is thought in the Stock Exchange that the company is bound to benefit by the agreements already made.

Notting Hill shares, although nominally unchanged in price, are a little duller, a good many of the old shares having been sold since the directors decided to make a new issue at £12. The sales have obviously been on behalf of shareholders who want the money in order to take up their new allotments, no substantial premium having so far been established upon these latter. On balance, there are more sellers than buyers in the supply market just now, for which the new issues so lately and so lavishly made must also be held responsible. As calls upon the latest emissions become due, so do proprietors part with a few of their older shares in order to meet the liabilities. This will go on until the new issues are fully paid, and we shall probably see a quiet market on this account for the next month or six weeks.

Fortunately the condition of the money market is gradually getting into a more healthy state, notwithstanding the large amount of money falling due in August upon the myriad of stocks and shares which came out during July, and for which the public subscribed tolerably well.

Central London shares remain a very good market, and are being largely bought for investment purposes. On the other hand, a good many stale bulls have seized the opportunity presented by the rise to take their profits, and the result has been that the price fluctuates pretty frequently within comparatively close limits. The half-shares are somewhat neglected, and the price of these is about ½ under that of the undivided. Waterloo and City stock shows no signs of recovering its recent drop of 6 per cent., nor do we see much hope for its doing so while the outlook for coal and materials remains so unsettled. In City and South London stock there is nothing doing.

Some slight demand has again arisen for the telegraph manufacturing group of shares upon the activity which now prevails in the industry. The Ordinary shares of the Telegraph Manufacturing Company are up 10s., and Henley's have been wanted, the Preference more particularly, as they pay a good rate of interest at the present price. The electric construction department is very sleepy. British Westinghouse Electric Preference are 5; Willans & Robinson Ordinary are steady at 11, the £5 Preferences remaining at 6⅞, and the Debenture stock at 106.

Traction shares are receiving very little attention. British Electric Traction new have improved to 1¼ premium, the old being 14⅛ middle. After last week's flutter of fear in connection with the Central London's competition, the 'bus companies' securities have quieted down again at reduced quotations. One curious development that has arisen on account of the new line is a fashion amongst members of the Stock Exchange for West End luncheons. Instead of going to their usual City haunts, a number of brokers and jobbers take the "Tube" daily to one of the West-end stations and lunch in Oxford Street or Piccadilly. A good idea during the hot weather!

The telegraph market shows a ¼ loss on the Direct United States Cable shares, that new German competition being again the bugbear, and a rise of the same amount in Eastern Extensions. "Chinas," in consequence, are now standing at a shade higher than Eastern Telegraph Ordinary. The rest of the market is unchanged since the beginning of the present month. We have already alluded to the rise in National Telephone first Preference shares. Singularly enough it has been accompanied by a drop in the price of the Ordinary, which is down 2s. 6d. on the week. This is due to the dealers being "full of shares" as they term it, and no buyers put in an appearance, the price has been lowered as a protection to the market against fresh sellers. The new National Telephones, now obtainable at 4⅛, are the better worth buying if an investor fancies the company's shares a good inlet for his capital.

SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1897.	1898.	1899.	Closing Quotation August 8th.	Closing Quotation August 15th.	Business done during week ended August 15th, 1900. Highest.	Lowest.
110,900	African Direct Telegraph, 4 % Debs.	100	...	...	...	99 —103	99 —103	...	...
125,000	Amazon Telegraph 5 % Debs., Nos. 1 to 1,250 Red. ...	100	...	...	...	85 ← 90	85 — 90	...	...
875,520	Anglo-American Telegraph	Stock	3 %	£3 9s.	73/6	58 — 61	58 — 61 xd	...	...
3,062,240	Do. do. 6 % Pref.	Stock	6 %	6 %	6 %	110½—111½	110½ 111½xd	111⅛	110½
3,062,240	Do. do. Deferred	Stock	...	18s. %	£1 7s.	12 — 12½	12 — 12½	12¼	12⅛
44,000	Chili Telephone, Nos. 1 to 44,000	5	4 %	3 %	4 %	2½— 3½	2½— 3½	...	...
10,000,000$	Commercial Cable	$100	8 %	8 %	...	165 —175	165 —175	...	...
1,563,078£	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	101 —103	101 —103	101½	...
16,000	Cuba Telegraph	10	7 %	8 %	7 %	6½— 7½	6½— 7½	...	...
6,000	Do. 10 % Pref.	10	10 %	10 %	...	15 — 16	15 — 16	15	...
12,931	Direct Spanish Telegraph	5	4 %	4 %	...	4 — 5	4 — 5	...	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	...	...	9 — 10	9 — 10	...	...
30,000	Do. do. 4½ % Debs.	50	...	...	...	100 —104%	100 —104 %	...	...
60,710£	Direct United States Cable	20	3¼%	3¼%	3 %	11¼— 11⅝	11 — 11⅛	11⅜	11⅛
111,000	Direct West India Cable, 4½ % Reg. Deb.	100	...	...	...	99 —102	99 —102	...	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	145 —150	145 —150	147½	145
1,795,000	Do. 3½ % Pref. Stock	100	...	...	...	96 — 99	96 — 99	...	...
1,432,268£	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	...	...	111 —116	111 —116	114½	...
250,000	Eastern Extension, Australasia, and China Telegraph ...	10	7 %	7 %	7 %	14½— 15	14⅜— 15¼	15⅛	14⅜
6,700£	Do. 5 % (Aus. Gov. Sub.) Deb., 1900, red. ann. drgs., reg. 1—1,049, 3,976—4,326	100	5 %	...	...	... — ...	... — ...	...	...
26,600£	Do. do. Bearer, 1,050—3,975, 4,327—6,400	100	5 %	...	...	... — ...	... — ...	...	...
320,000£	Do. 4 % Deb. Stock	Stock	4 %	...	...	110 —115	110 —115 xd	...	...
300,000£	Eastern and South African Telegraph, 4 % Mort. Deb. Nos. 1 to 3,000, red. 1909	100	...	...	...	99 —102	99 —102 xd	99	...
200,000£	Do. 4 % Reg. Mt. Debs. (Mauritius Sub.) 1—8,000	25	...	...	...	100 —103%	100 —103%	...	...
180,227	Globe Telegraph and Trust	10	4½%	5⅛%	5¼%	11¼— 11⅜	11 —11⅛	11⅜	11⅜
180,042	Do. do. 6 % Pref.	10	6 %	6 %	...	15 — 15½	14⅜— 15¼	15⅛	15
150,000	Great Northern Telegraph, of Copenhagen	10	10 %	12½%	...	31 — 33	31 — 33	32	...
84,300	Halifax and Bermuda Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	98 —101	98 —101	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	10 %	52 — 56	52 — 56	...	...
100,000£	London Platino-Brazilian Telegraph, 6 % Debs.	100	6 %	...	...	105 —108	105 —108	...	...
72,680	Montevideo Telephone, Limited, Ord., Nos. 1 to 72,680 ...	1	...	...	...	¼— ½	¼— ½	...	...
86,492	Do. do. do. 5 % Pref., Nos. 1 to 86,492	1	4 %	4 %	2½%	½— 1	½— 1	...	...
490,000	National Telephone, 1 to 490,000	5	6 %	6 %	5 %	4⅜— 5	4⅜— 4⅞	4⅞	4⅜
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	12 — 14	13 — 15	...	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	12 — 14	12 — 14 xd	13½	13½
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	6 %	4⅞— 5⅛	4⅞— 5⅛xd	5 1/16	4 15/16
2,000,000£	Do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	97 —100	97 —100	99½	99
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	5 %	5 %	⅞— 1⅛	⅞— 1⅛	...	...
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 ...	100	4 %	...	...	100 —103	100 —103	...	...
11,839	Reuter's	8	5 %	5 %	5 %	7½— 8½	7½— 8½	...	...
3,381	Submarine Cables Trust	Cert.	...	...	...	125 —130	125 —130	125	...
58,000	United River Plate Telephone	5	5 %	6 %	7 %	4⅜— 5¼	4⅜— 5¼	5 1/16	...
16,639	Do. do. 5 % Cum. pref. Nos. 1—16,639	5	...	...	...	5 — 5¼	5 — 5¼	...	...
179,947	Do. do. 5 % Debs.	Stock	...	...	...	104 —107	104 —107	...	...
200,000£	West African Telegraph, 5 % Debs....	100	...	...	...	98 —101	98 —101	...	...
30,008	West Coast of America, Nos. 1—30,000 and 53,001—53,008	2½	...	...	...	½— 1	½— 1	...	...
150,000	Do. do. 4 % Debs., 1—1,500 gua. by Braz. Sub. Tel.	100	...	...	...	99 —102	99 —102	...	...
389,731	Western and Brazilian Telegraph 4 % Deb. Stock Red. ...	Stock	...	...	...	... — ...	... — ...	...	...
207,930	Western Telegraph, Ltd., Nos. 1—207,930	10	7 %	7 %	...	14⅜— 15¼	14⅜—15¼ xd	15 1/16	15
75,000	Do. do. 5 % Debs. 2nd series, 1906 ...	100	...	...	...	103 —106	103 —106	...	...
88,321	West India and Panama Telegraph	10	¾%	2 %	⅝%	⅝— ⅞	⅝— ⅞	...	...
34,563	Do. do. do. 6 % Cum. 1st Pref. ...	10	6 %	...	...	6½— 7½	6½— 7½	...	...
4,669	Do. do. do. 6 % Cum. 2nd Pref. ...	10	6 %	...	...	6 — 7	6 — 7	...	...
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	5 %	...	...	102 —105	102 —105	...	...

ELECTRICITY SUPPLY COMPANIES.

19,661	Brompton & Kensington Elec. Lt. Sup., Ord., 101 to 19,761	5	4 %	6 %	6 %	7 — 8	7 — 8	...	...
12,000	Do. do. 7 % Cum. Pref....	5	7 %	...	...	8½— 9½	8½— 9½	...	...
50,000	Charing Cross and Strand Electricity Supply	5	7 %	8 %	9 %	9½— 10½	9 — 10	..	...
20,000	Do. do. do. do. 4½% Cum. Pref.	5	...	...	...	5½— 5⅝	5 — 5½	...	...
34,000	*Chelsea Electricity Supply, Ord.	5	6 %	6 %	6 %	6½— 7½	6½— 7½	...	...
150,000	Do. do. do. % Deb. Stock Red. ...	Stock	4½%	...	...	108 —111	108 —111	...	...
60,000	City of London Electric Lighting, Ord. 40,001—100,000...	10	10 %	6 %	4 %	8 — 9	7½— 8½	8 7/16	7⅜
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	...	12 — 13	12 — 13	12⅜	12⅜
400,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	...	...	123 —128	123 —128	125	...
40,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000	10	*nil*	*nil*	4 %	8½— 9½	8½— 9½	9⅛	8 1/16
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	...	11½— 12½	11 — 12	11¼	...
200,000	Do. 4½ % Deb. Stock, Prov. Certs (all paid) Rd. ...	...	...	...	...	107 —110	107 —110	109	...
26,100	Edmundson's Elec. Corp., Ord. Shares	5	5 %	7 %	...	4½— 5	4½— 5	...	...
75,000	Do. do. 4½ % 1st Mort. Deb. Stock. ...	100	...	...	...	99 —102	99 —102	...	...
110,000	London Electric Supply Corporation, Limited, Ord. ...	3	...	...	...	1 — 1½	1 — 1½	...	...
49,840	Do. do. do. do. 6 % Pref.	5	...	6 %	...	4 — 4½	4 — 4½	4 1/16	...
250,000	Do. do. do. 4% 1st Mt. Db. Stock Rd.	Stock	...	...	...	98 —100	98 —100	...	...
85,000	Metropolitan Electric Supply, 101 to 62,500	10	6 %	5 %	5 %	14½— 15½	14 — 15	15¼	15⅛
220,000£	Do. 4½% First Mortgage Debenture Stock	...	4½%	...	...	111 —114	111 —114	...	...
220,000	Do. 3½% Mort. Deb. Stock Red.	Stock	...	...	...	96 — 98	96 — 98	98	96
6,452	Notting Hill Electric Lighting	10	6 %	6 %	7 %	15½— 16½	15 — 16	...	...
40,000	St. James's and Pall Mall Electric Light, Ord.	5	14½%	14½%	14½%	14 — 15	14 — 15 xd	...	...
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	8 — 9	8 — 9 xd	8⅛	...
12,000	Smithfield Market Elect. Supply, Ord.	5	...	...	...	2 — 2½	2 — 2¼	...	...
50,000	Do. do. 4 % Deb.	100	...	...	...	85 — 95	85 — 95 xd	...	...
65,000	South London Electricity Supply, Ord.	5	...	...	...	3 — 4	3 — 4	3 1/16	...
79,900	Westminster Electric Supply, Ord., 101 to 80,000... ...	5	12 %	12 %	13 %	12 — 13	12 — 13	12⅞	12⅜

* Subject to Founders Shares. † Quotations on Liverpool Stock Exchange.
‡ Unless otherwise stated all shares are fully paid. ‖ Dividends paid in deferred share warrants, profits being used as capital.
Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES.—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share.	Dividends for the last three years. 1897.	1898.	1899.	Closing Quotation Aug. 8th.	Closing Quotation Aug. 15th.	Business done week ended Aug. 15th, 1900. Highest.	Lowest.
		‡							
65,000	Aluminium shares, Nos. 1—65,000	1	10 %	20 %	...	2⅞— 3⅛	2⅞— 3⅛	3	...
90,000	Do. 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	96 —101	96 —101	...	...
30,000	British Electric Traction	10	...	6 %	...	14 — 15	14 — 15	14⅝	...
50,000	Do. do. 6 % Cum. Pref.	10	...	...	...	12 — 13	12 — 13	12¾	12 9/16
200,000	Do. do. 5 % Perpetual Debenture Stock ...	Stock	...	...	...	123 —126	123 —126	...	...
85,000*l*	†British Electric Works Co., Ord. £1 shares, 50,001—135,000	...	...	...	...	¾— ⅞	¾— ⅞	...	...
50,000	† Do do. 6 % Cum.Pref., 1—50,000 ...	...	...	...	...	1 3/16— 1 5/16	1 3/16— 1 5/16	...	...
500	† Do. do. 4½ % 1st Mort. Deb.	100	...	...	...	97 — 99	97 — 99	...	...
40,000	British Insulated Wire Ord., Nos. 1 to 40,000 ...	5	15 %	15 %	20 %	11½— 12½	11½— 12½xd	...	...
27,500	Do. do. 6 % Cum. Pref. Nos. 1 to 27,000 ...	5	...	...	...	5¾— 6¼	5¾— 6¼xd	...	...
90,000	Brush Elecl. Enging., Ord., 1 to 90,000	3	3 %	5 %	...	1⅝— 1⅞	1⅝— 1⅞	...	...
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000 ...	2	6 %	6 %	...	2⅛— 2⅜	2 — 2¼	2⅛	...
125,000*l*	Do. do. 4½ % Perp. Deb. Stock ...	Stock	...	...	...	108 —113	108 —113	...	...
50,000	Do. do. 4½ % 2nd Deb. Stock Red ...	Stock	...	...	...	101 —103	101 —103	...	...
20,000	Callender's Cable Construction shares, Nos. 1—20,000	5	12½ %	15 %	15 %	13 — 14	13 — 14	...	...
20,000	Do. do. 5 % Cum. Pref.	5	...	...	...	5¼— 5⅝	5¼— 5⅝	...	...
90,000	Do. do. 4½ % 1st Mort. Deb. Stock Red ...	Stock	...	...	...	110 —114	110 —114	...	...
213,533	Central London Railway, Ord. Shares	10	...	...	...	10 — 10½	10 — 10½	10⅝	10⅛
61,033	Do. do. Pref. half-shares	5	...	...	...	5 — 5⅛	5 — 5⅛	5⅛	...
71,447	Do. do. Def. do.	5	...	...	...	5 — 5⅛	5 — 5⅛	5⅛	5¼
855,000	City and South London Railway	Stock	1⅞%	2⅛%	1⅞%	56 — 59	55 — 58	56¼	56
37,500	Do. do. Ord. shares Nos. 22,501 to 60,000 ...	10	...	...	...	6 — 7	5 — 6	...	...
32,098	Crompton & Co., Nos. 1 to 32,098	3	...	6 %	7½%	3¾— 4¼	3¾— 4¼	...	...
100,000	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 red	...	...	...	...	99 —102	99 —102	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	6 %	6 %	6 %	2 — 2⅛	1¾— 2¼	...	...
17,139	Do. do. do. "A" Shares, 01—017,139 ...	5	6 %	6 %	6 %	3½— 4¼	3¾— 4¼	...	...
344,023	Do. do. do. 4 % Deb. Stock Red ...	100	...	...	...	91 — 93	91 — 93	...	...
112,100	Electric Construction, 1 to 112,100	2	6 %	6 %	6 %	1⅞— 2⅛	1⅞— 2⅛	...	...
25,000	Do. do. 7 % Cum. Pref., 1 to 25,000...	2	7 %	7 %	...	2¾— 3¼	2¾— 3¼xd	2	1 1/16
140,300	Do. do. 4 % Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	102 —105	102 —105	103	102½
9,600*l*	Greenwood & Batley, 7 % Cum. Pref., 1 to 9,600 ...	10	7 %	7 %	7 %	10 — 11	10 — 11	...	...
30,000	Henley's (W. T.) Telegraph Works, Ord.	5	12 %	14 %	15 %	13 — 14	13 — 14	...	...
30,000	Do. do. do. 4½ % Pref.	5	7 %	7 %	...	5¼— 5⅜	5 — 5¼	5¼	...
50,000	Do. do. do. 4½ Mort. Deb. Stock...	Stock	4½%	...	...	110 —114	110 —114	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	...	21 — 22	21 — 22	21¼	...
300,000	Do. do. do. 4 % 1st Mort. Deb	100	...	...	...	101 —104	101 —104	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	3¼%	3¼%	3⅜%	9 3/16— 9 5/16	8 15/16— 9 1/16	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	5 %	13¼— 13½	13 — 13½	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	15 %	15 %	35 — 39	35 — 39xd	36⅜	...
150,000	Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909 ...	100	...	...	...	101 — 104	101 —104	...	...
20,000	Telegraph Manufacturing, Ord. Nos. 1 to 20,000	5	...	8 %	12 %	10 — 11	10½— 11½	10⅞	10⅜
20,000	Do. do. 5 % Cm. Prf. Nos. 1 to 20,000 ...	5	...	...	...	5¼— 5⅜	5¼— 5⅜	...	...
540,000*l*	Waterloo and City Railway, Ord. Stock	100	...	3 %	3 %	90 — 93	89 — 92 xd	...	...

† Quotations on Liverpool Stock Exchange.

‡ Unless otherwise stated all shares are fully paid.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

*Birmingham Electric Supply, Ordinary £5 (fully paid) 8—10.
Brompton and Kensington, 4½ % Debentures of £100, 104—107.
National Electric Free Wiring, 12/6 paid, ⅜—½.
Oldham, Ashton, and Hyde Electric (£10 pd.), Ord., 16½—17½.
Do. do. Pref. (£10 pd.), 10—11.
Kensington and Knightsbridge Electric Lighting, Ordinary Shares £5 (fully paid) 12—13; 1st Preference Cumulative 6 % £5 (fully paid), 7—7⅛. Debentures, 102—105. Dividend, 1899, on Ordinary Shares 11 %.
*T. Parker, £10 (fully paid), 17½.

* From Birmingham Share List.

Bank rate of discount 4 per cent. (July 19th, 1900).

MARKET QUOTATIONS, Wednesday, August 15th.

CHEMICALS, &c.		This week.	Last week.	Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	5/-	..
a ,, Nitric	per cwt.	22/-	22/-	..
a ,, Oxalic	per cwt.	32/-	32/-	..
a ,, Sulphuric	per cwt.	5/6	5/6	..
a Ammoniac, Sal	per cwt.	39/-	39/-	..
a Ammonia, Muriate (crystal) ..	per ton	£33	£33	..
a ,, ,, ..	per ton	£30	£30	..
a Bleaching powder	per ton	£7	£7	..
a Bisulphide of Carbon	per ton	£15	£15	..
a Borax	per ton	£17	£17	..
a Bensole (90 %)	per gal.	7/-	7/-	..
a ,, (50/90%)	per gal.	5/6	5/6	..
a Copper Sulphate	per ton	£25 10	£25 10	..
a Lead, Nitrate	per ton	£25	£25	..
a ,, White Sugar	per ton	£31	£31	..
a ,, Peroxide	per ton	£27 10	£27 10	..
a Methylated Spirit	per gal.	2/6	2/6	..
a Naphtha, Solvent (90% at 160° C).	per gal.	5/6	5/6	..
a Potash, Bichromate, in casks..	per lb.	3¼d.	3¼d.	..
a ,, Caustic (75/80%) ..	per ton	£24	£24	..
a ,, Bisulphate	per ton	£35	£35	..
a Shellac	per cwt.	68/-	68/-	..
a Sulphate of Magnesia	per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers ..	per ton	£6	£6	..
a ,, Recovered	per ton	£5 10	£5 10	..
a ,, Lump	per ton	£5	£5	..
a Soda, Caustic (white 70 %) ..	per ton	£10 15	£10 15	..
a ,, Crystals	per ton	£3	£3	..
a ,, Bichromate, casks ..	per lb.	2¾d.	3¼d.	..
METALS, &c.				
b Aluminium Wire, in ton lots..	per ton	£224	£224	..
b ,, Sheet, in ton lots	per ton	£191	£191	..
p Babbitt's metal ingots.. ..	per ton	£80 to £150	£80 to 150	..
c Brass (rolled metal 2" to 12") basis	per lb.	7¾d.	7¾d.	..
c ,, Tube (brazed)	per lb.	10d.	10d.	..
c ,, ,, (solid drawn) ..	per lb.	8¾d.	8¾d.	..
c ,, Wire, basis	per lb.	8¾d.	8¾d.	..
c Copper Tubes (brazed) ..	per lb.	11¼d.	11¼d.	..
c ,, ,, (solid drawn) ..	per lb.	11d.	11d.	..
g Copper Bars (best selected) ..	per ton	£86	£85	20s. inc.

METALS, &c. *(continued.)*		This week.	Last week.	Inc. or Dec.
g Copper Sheet	per ton	£86	£85	£1 inc.
g ,, Rod	per ton	£86	£85	£1 inc.
e ,, (Electrolytic) Bars ..	per ton	£83 10	£82 10	£1 inc.
e ,, ,, Sheets ..	per ton	£92	£90	£2 inc.
e ,, ,, Rod ..	per ton	£85 10	£84	30s. inc.
e ,, ,, H.C. Wire	per lb.	9¾d.	9¼d.	¼d. inc.
f Ebonite Rod	per lb.	3/-	3/-	..
f ,, Sheet	per lb.	5/-	5/-	..
n German Silver Wire	per lb.	1/6	1/6	..
h Gutta-percha fine	per lb.	..	..	..
h India-rubber, Para fine	per lb.	3/11½ to 4/2½	3/10½ to 4/0½	inc.
i Iron, Charcoal Sheets	per ton	£18	£18	..
i ,, Pig (Cleveland warrants) ..	per ton	71/6	69/6	2s. inc.
i ,, Forgings, according to size	per ton	From £11	From £11	..
i ,, Scrap, heavy	per ton	70/- to 72/6	70/- to 72/6	..
i ,, Wire, galvanised No. 8 ..	per ton	£12 15	£12 15	..
g Lead, English Ingot	per ton	£17 12 6 to £17 17 6	£17 12 6 to £17 17 6	..
g ,, ,, Sheet	per ton	£19	£19	..
m Manganin Wire No. 28	per lb.	8/-	8/-	..
g Mercury	per bot.	£9 10	£9 10	..
d Mica (in original cases), small ..	per lb.	3d. to 9d.	3d. to 9d.	..
d ,, ,, ,, medium	per lb.	1/9 to 2/9	1/9 to 2/9	..
d ,, ,, ,, large ..	per lb.	3/3 to 7/3	3/3 to 7/3	..
p Phosphor Bronze, plain castings	per lb.	1/1 to 1/4	1/1 to 1/4	..
p ,, rolled bars & rods	per lb.	1/1 to 1/4	1/1 to 1/4	..
p ,, ,, strip & sheet	per lb.	From 1/3	From 1/3	..
o Platinum	per oz.	£3 13 6	£3 13 6	..
p Silicon Bronze Wire	per lb.	10½d. to 1/1	10½d. to 1/1	..
i Steel, Magnet, acc'd'ng to desc'p'n	per ton	From £15 to £40	From £15 to £40	..
i ,, ,, in bars		£58	£58	..
g Tin, block	per ton	£145 10 to £146	£147 to £148	dec.
g ,, foil	per lb.	2/-	2/-	..
n ,, wire, Nos. 1 to 16	per lb.	1/9	1/9	..
p White Anti-friction Metals — "White Ant" brand	per ton	£40 to £70	£40 to £70	..
j Yarns, Cotton, Single 10 lb b'ndl's	per lb.	8¼d.	8¼d.	..
j ,, Best Flax, 6 lbs.	per lb.	6d.	6d.	..
j ,, Hemp, 3 ply 10 lbs. ..	per lb.	4½d.	4½d.	..
j ,, ,, Russian, 10 lbs. ..	per lb.	5½d.	5½d.	..
j ,, Jute, 180 lbs. rove ..	per ton	£14	£14	..
k Zinc, Sh't. (Vielle Montagne ond.)	per ton	£24 5 nett.	£24 5 nett.	..

Quotations supplied by { a Messrs. G. Boor & Co. b The British Aluminium Co., Ltd. c Messrs. Thos. Bolton & Sons. d Messrs. F. Wiggins & Sons. e Messrs. Frederick Smith & Co.

Quotations supplied by { f India-Rubber, G.-P. and Teleg. Works g Messrs. James & Shakspeare. [Co., Ltd. h Messrs. Jackson & Till. i Messrs. Bolling & Lowe. j Messrs. Henry C. Yeo & Co.

Quotations supplied by { k Messrs. Morris Ashby, Limited. m Messrs. W. T. Glover & Co., Ltd. n Messrs. P. Ormiston & Sons. o Messrs. Johnson, Matthey & Co., L p The Phosphor Bronze Company.

NSTITUTION OF ELECTRICAL ENGINEERS.

ALTERNATING CURRENT INDUCTION MOTORS.

By A. C. Eborall, Associate.

(*Paper read May 17th*, 1900.)

(*Concluded from page* 237.)

Performance.—The Heyland motors standardised for circuits of 40, 50, and 60 cycles are designed in three ways, as follows:—

(*a*) To start without load. Under these circumstances the starting current does not exceed four-fifths of the full-load running current.

(*b*) To start with two-thirds of the full-load torque. Under these circumstances the starting current does not exceed 1½ times the full-load running current.

(*c*) To start with full load torque. Under these circumstances the starting current does not exceed twice the full load running current.

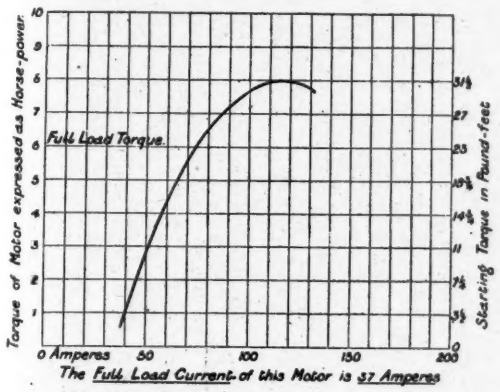

Torque of Motor expressed as Horse-power.
Starting Torque in Pound-feet
Full Load Torque.
0 Amperes 50 100 150 200
The Full Load Current of this Motor is 37 Amperes

Fig. 11.

Design (*a*) has been evolved in order to conform to the ideas of many station engineers in this country. Design (*c*) represents the normal winding, while design (*b*) is frequently asked for. The starting torque with the standard stampings is determined purely by the number of turns of the starting coils and the permissible current. This torque can be arranged to have a value equal to two or three times the full load running torque, if enough current is given to the starting coils, the limiting value occurring at the saturation point of the iron.

Figs. 11 and 12 illustrate the starting performance of two motors designed to fulfil conditions (*b*) and (*c*) respectively, while fig. 13 illustrates the running performance of the motor whose starting curve is given by fig. 11. All these curves represent the results of actual brake tests, and many motors built have given better results than indicated here.

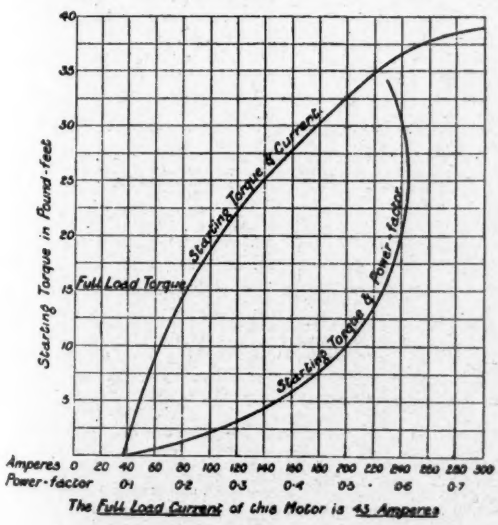

Starting Torque in Pound-feet
Starting Torque & Current
Starting Torque & Power-factor
Full Load Torque
Amperes 0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300
Power-factor 0·1 0·2 0·3 0·4 0·5 0·6 0·7
The Full Load Current of this Motor is 43 Amperes

Fig. 12.

Particular attention is given in all the designs to the overload capacity of the motor, and all motors are guaranteed to stand a 25 per cent. overload for one hour. The small overload capacity (varying from 0 to 10 per cent.) found with the alternating current motors hitherto used* has been one of their worst features, as for most work it is impossible to fix the amount of power required so exactly as this, with the result that the motors installed are invariably too large and costly for the work they have to do. This reacts on consumer and supply company alike: the former has to pay for a larger motor than he wants, which will be working on the average at low efficiency, while the latter most of the time is supplying an underloaded motor, having a low power-factor.

The results obtained with the Heyland motors for circuits of 80 and 100 cycles are not quite so good as those given above, with regard to starting torque. That is to say, these high frequency motors as built up to the present take a relatively greater current

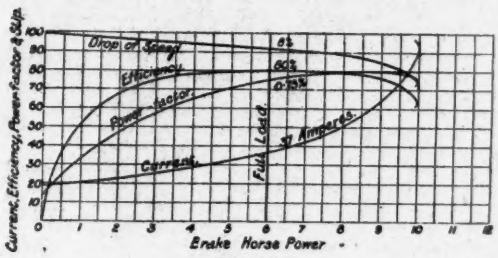


Fig. 13.

for a given value of starting torque, the values being—(*a*) when starting without load current is equal to the full-load current; (*b*) starting with half the full-load torque the current is 1½ times the full-load current; (*c*) starting with full-load torque the current consumption is 2½ to 3 times the full-load current. The increased values of current consumption are, of course, due to the larger number of poles necessary to bring the speed to a reasonable figure; particularly in small motors the number of poles has a very great effect on the amount of magnetic leakage with a given design.

As, however, the Heyland motors are not yet fully standardised for 80 and 100 cycles, the designers hope to effect considerable improvements within the next few months in the direction of reducing the current for a given value of starting torque.

Before leaving the subject of these motors the author would like to draw attention to an exceedingly neat method Mr. Heyland has devised for regulating the speed of induction motors, single and polyphase.

As is well known, there are two principal ways of altering the speed of such motors, the supply frequency being constant.† The first is by rheostatic control, a non-inductive regulating resistance being in circuit with the rotor windings, while the stator windings are connected directly to the mains; the second is by altering the number of stator poles by means of a suitable controller, together with

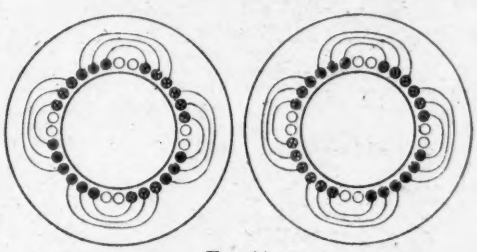


Fig. 14.

those of the rotor, unless the latter is of the "squirrel cage" type. Here the motor is wound for the maximum number of poles, and when it becomes necessary to pass from a greater to a less pole number, in order to get increased speed, the windings on some of the poles are reversed, thus producing fewer poles, which are in consequence much broader. For instance, in order to double the speed, half the poles have their windings reversed, the stator having now half the number of poles, each of double the former breadth. While rheostatic control is simple and easy to use, it has the great objection of being very uneconomical. The waste of energy brought about by its use is entirely analogous to that found with shunt-wound direct current motors, with constant field excitation and a regulating resistance in the armature. The case of the induction motor is really more unfavourable, because it has been found by experience that the motor has to be rated very liberally, in order to get the necessary power.

On the other hand, the method of altering the number of motor poles has two serious disadvantages. Firstly, the reduction of the number of poles causes an unfavourable distribution of the magnetic

* The author would here like to make an exception in favour of the Wenström motor, whose overload capacity (as found with examples tested by him) is everything that can be desired.

† The method of "tandem parallel control" for two motors while excellent theoretically, is hardly likely to come into commercial use at present, on account of the great complication involved, and because of the bad conditions under which the motors have to work.

flux, a large increase of magnetic leakage and a loss of winding space. This is of course owing to the fact that after the reversal of the appropriate coils the currents flowing down one side of these coils are neutralised by the currents in the adjacent side of the unreversed coils, as will be readily seen from fig. 14 illustrating the single-phase case.

Secondly, unless the motor has a squirrel cage rotor, the rotor circuits become very complicated; the polarity of the rotor windings has to be changed each time in accordance with the stator polarity, which means that a large number of slip-rings have to be used, in order that this may be done.

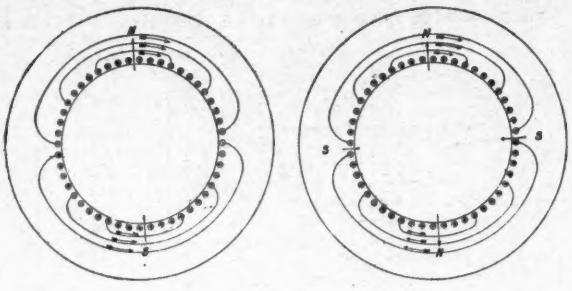
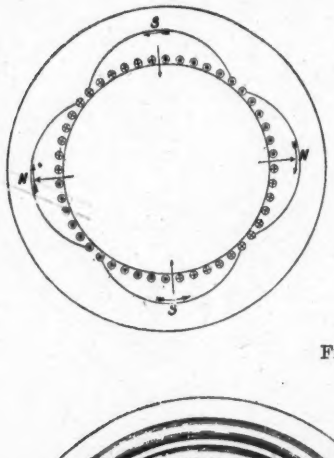


Fig. 15.

Mr. Heyland's method consists of certain winding arrangements which, when it is desired to change the number of poles, render any reversal of the rotor windings superfluous, and to a large extent obviate the drawbacks stated above in the reversal of the stator coils.

The method of winding the stator as applied to single-phase motors is illustrated in figs. 15, 16, 17, and 18, the last figure showing how the stator coils are wound in practice. In all cases the winding is carried out for the smaller number of poles, and divided into sections, one or more of these sections being reversed to obtain a greater number of poles. Thus, for instance, in fig. 15 the stator being wound initially for two poles, by reversing one of the sections of the winding a four-pole stator results, as indicated, and it will be seen at a glance that there is no neutralising action between adjacent conductors, and that the distribution of magnetic flux in the air-gap will be perfectly good. Fig. 16 shows the arrangement for a four-pole to eight-pole stator, and fig. 17 that for a six-pole to 12-pole, to which the same remarks apply. The manner of carrying out the stator winding for the last case actually employed is illustrated in fig. 18.



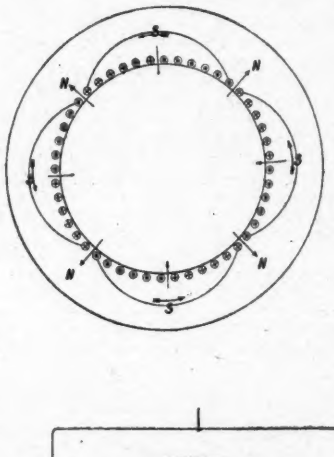


Fig. 16.

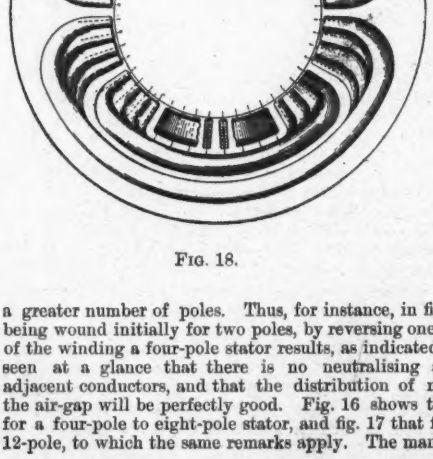


Fig. 18.

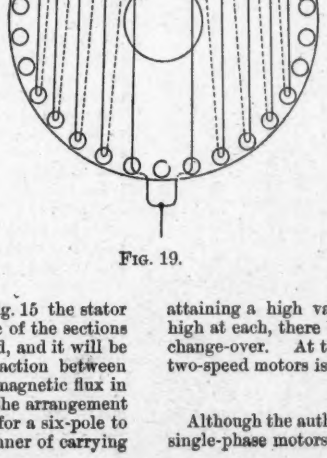


Fig. 19.

For polyphase motors exactly the same winding arrangements are used, applied, of course, to each phase. For these motors, if more than one change of speed is desired, the controllers get somewhat expensive, and it is, therefore, better on the whole in such cases to combine the method with rheostatic (rotor) control, the rheostat being used for the intermediate speeds only.

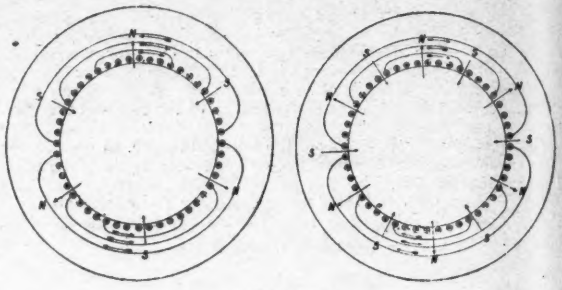


Fig. 17.

For small motors having squirrel-cage rotors, no modification of the rotor winding is needed; but where wound rotors are employed the general method of rotor winding is illustrated in fig. 19, which illustrates the single-phase case for simplicity. The general principle is to so arrange the windings of each phase that they are formed of a number of sections in parallel; with a certain number of poles, the E.M.F. of one section will neutralise that of another section in parallel to it, and a current will flow through the sections only when they are externally short-circuited; on the other hand, with double the number of poles, the external short-circuit is superfluous. Thus consider fig. 19, representing (diagrammatically) the winding for one phase of the rotor for a two-pole—four-pole stator. Each phase has two sections, permanently short-circuited one on the other. At starting, the stator switch is put over to the four-pole position, and the slip-rings gradually closed through the starting resistance. So long as the slip-rings are open, no currents flow in the rotor windings, as the induced E.M.F. has the same value in each section, and the two E.M.Fs. neutralise one another, on account of the four stator poles. But the rotor currents circulate as soon as the rings are connected through the resistance; this latter is gradually cut out in the usual way as the motor comes up to speed. In changing over now to the two-pole position (if the higher speed is required) the slip-rings are not wanted, as the two sections are now in series, with the E.M.F. in the same direction, and so the rotor currents can circulate independently of the external short-circuit.

The same general arrangement is used for motors to run at more than two speeds. Here the rotor windings (per phase) can have more than two sections, these sections being wound partly to overlap one another, while still being in parallel, so that the various E.M.Fs. partly neutralise one another, and partly add themselves together. With this arrangement the same rotor winding can be effectively used with a stator having several different arrangements of the poles—that is, for a motor running at several distinct speeds.

For induction motors having rotors with star-connected three-phase windings, which is the practical case, only three slip-rings are required, the (second) common junction being at the three slip-rings, as usual.

In the workshops of the author's firm, where many of the tools are driven by three-phase motors, the Heyland method of speed regulation is employed with great convenience. Several of the larger tools (such as planing machines and the like) are driven by independent three-phase motors wound for two speeds, the alteration of speed being effected by throwing over the reversing switch. It has been found by tests on these motors that the power factor is diminished very little by the increase in the number of poles, attaining a high value at both speeds, while the efficiency is also high at each, there being but slight loss of energy involved by the change-over. At the same time, the increase of first cost with the two-speed motors is very small.

Concluding Remarks.

Although the author has dealt at some length upon the subject of single-phase motors, it has been more on account of the technical

interest attached to it than because of any belief in the present or future possibilities of single-phase systems. Regarding the Continent and the States it is not too much to say that single-phase supply is practically played out, and that engineers responsible for putting down new stations for either power or lighting consider single-phase supply systems out of date and their employment bad practice. Moreover, indications are not wanting that the present tendency in this country is to follow in the same direction. It is certain that for all those cases where continuous-current systems are out of the question every requirement can be far more successfully met by three-phase systems than by any other. It is true that certain engineers in this country hold the opinion that pressure regulation troubles are bound to occur with three-phase working (an opinion not shared by the author), but, even supposing this to be the case, the complete solution is to hand—convert to continuous current by means of rotaries, or better, by means of motor generators.

The standardisation of the above two systems, together with that of two voltages for each system—220 and 440 volts—and one frequency—50 cycles—for the supply networks, is greatly to be desired, particularly from the point of view of the motor manufacturer and the motor user. With the hope that this ideal may be eventually realised, this paper can be concluded.

AUTOMOBILES AS SOURCE OF REVENUE FOR CENTRAL STATIONS.*

By ELMER A. SPERRY.

One year ago, in New York, predictions, optimistic in their general tone, were made as to the rapid and general adoption of electric road vehicles, and some disappointment has been felt by station managers that more substantial advancement toward heavy demands for current has not yet been forthcoming for this purpose. Managers will recall that during the year frequent inquiries have been made that have not resulted in desirable business.

It is my purpose to outline briefly some of the factors that have contributed to these unfavourable conditions, and to record some advances made. It has been discovered in many instances that the demand for current is not so favourably located on the load curve or on the network as was hoped. For instance, electric delivery wagons required charge at times of heavy load and on the part of the network heavily taxed in lighting. Again, the factors controlling the seasons of the heavy demand for lighting during the year are found identical and in phase with those requiring heavy duty of commercial electric vehicles. The carriage of the shopper and the delivery vans are both more active at these seasons. Furthermore, the same weather conditions producing heavy traction at the same time increases the demand for light. In a word, the diversity factor that it was hoped would be introduced with the automobile has not been in evidence.

Many of these difficulties may be made to disappear entirely, and diversity factor be developed that is practically ideal, by the simple device of duplicating the traction batteries. Where this has been done, it has been found that the charging can go forward at times and rates dictated by the station, and practically under its control. No hardships need be experienced by rigid conformance with this practice. Careless infringement with this principle may be remedied in a number of ways. The employment of two-rate meters has been suggested.

The station management has not in all instances been able to conceal disappointment at the unfavourable developments along some of the lines above pointed out, and has allowed it to react back to inquirers. I regret to say that prospective customers have in some instances been embarrassed by want of co-operation, aid and enthusiasm, justly expected from the management. Opportunities have thus been lost to encourage the industry, as the results that are now assured amply justify, as I shall endeavour to show.

Mechanical traction is coming rapidly to the front. Animal power is being superseded on every hand, and, especially for commercial uses, a universal effort is being made to break away from the horse and place roadwork on a mechanical basis. As a source of power, the mechanical is found to be simpler, more reliable and shrouded in far less mystery than the cellular-tissue-nerve combination. It should not be out of place, before this body, to recall some of the evident merits and advantages of the electric over other automobile systems. The perfect storage battery presents some remarkable features; it even rivals the electric motor itself in its fitness and special adaptability to the automobile problem. Its very large reserve power at instant command; its entire freedom from danger when fully charged; its almost constant pressure throughout its capacity—mark its superiority. This straight line of discharge of the battery is not matched by any other power-storage system of which we have knowledge. The recently developed capacity for quick charging and the ease with which the charge may be obtained in almost any hamlet in the country are among its advantages.

It has long been supposed that compressed air is an ideal form of stored power, but it is safe to say that electric storage distances compressed air in all the important features. Reliable batteries are now available and on the market that will yield for each 100 lbs. 1·8 H.P.-hours. Compressed air will yield to every 100 lbs. (air and tank, exclusive of reheater) $\frac{3}{10}$ths H.P.-hour, or six times the power for electric that it is possible to obtain from air. This result will be a surprise to some engineers. The fact that with the electric system we have a rotary motor of ideal simplicity, with a capacity for overload, coupled with an efficiency that is nothing short of wonderful, contributes inestimably to the success of electric-motor-driven systems, and is in marked contrast to the multiplicity of compounded, reciprocating engines employed as motors by our compressed-air friends.

The single feature of the constantly increasing cost of supply of fuel-using vehicles has already driven the makers to the extremity of seriously considering alcohol, with its weak power factor, as a possible substitute for the lighter petroleum products. The thoughtful engineer is constantly confronted with conditions indicating that in the realm of power coal is king, and only those traction systems that are organised to derive power from this source will keep to the front. This point, coupled with the electric system, is responsible for the stupendous development in present urban or street traffic. To show its superiority over all other powers, one need only recall the total absence of either steam or gasoline street cars. Germane to this subject, the question is often asked, Will automobiles replace street cars? Its great flexibility and independence of track certainly render the new claimant an ideal urban conveyance. Can the central station man look forward to supplying so large a demand as would thus be created?

The automobile, under street car conditions, brings forward an interesting field of inquiry. The single fact that the stupendous cost of permanent way and its maintenance is at once eliminated makes the problem of more than ordinary importance. The interest and income on these two items would yield so large a sum as easily to offset much extra expense of operation, and especially expense attending the development and smoothing out of the early workings, and covering the expense of adjusting a system of this magnitude to new conditions. Such a system would, however, be subject to certain limitations, chief among which will be found decreased weight per passenger, difficulty of easily directing the excessively heavy structure, large increase in power per passenger carried, increased rolling friction factor, and—one of the most important—the limitation as to roadbed, soft tires being precluded by the excessive tonnage. Considering these factors separately and collectively, the point is at once reached, showing conclusively that with anything like wheel pressures equal to that now obtaining in street railway service, nothing but steel pavement could be practically employed. To demonstrate this matter tests were made as follows:—Asphalt roadbed was taken as the standard roadbed of the future. A piece of very hard asphaltum, laid in the most approved manner and in constant use for two years, was selected. This had been maintained at an average temperature of 38° for 18 hours (no sun), the highest temperature during this time being 46° at time of test. A 62-inch wheel, with 3½-inch steel tire, was loaded to 5,000 lbs. on scale. This wheel was taken over various parts of the hard asphaltum, with the following results:—Once over, average depression, ·029 inch; twice over, average depression, ·047 inch. These depths were taken by a micrometer depth gauge, easily reading to one-fifth of a thousandth of an inch, and some 30 readings were taken in each instance. It will be noticed that this depression is somewhat over one-and-one-half thirty-seconds of an inch. The amount of this depression is surprising, considering the comparatively light load, broad tire, large wheel, extremely firm condition of the roadbed, and the temperature at which the asphaltum was tested, and seems to bear out the statement that the real limitations are probably more those of roadbed than of any other one factor.

Another factor destined greatly to increase the radius of action of electric vehicles, and the consequent demand for power, is roadway improvement. The present good roads agitation is certainly in line of progress, and should be given all possible aid and encouragement. In this connection, I see no reason why we could not wisely follow the plan, based on historical precedent, of utilising for this important work of permanent improvement our convict labour, the disposition of which in this country has always been a source of embarrassment to the authorities. This system certainly has much to recommend it, and the improvement of our roadways calls for a vast expenditure of labour, and has much need of a uniform and systematic effort.

The fact remains, and has been emphasised within the past year, that progress in electric vehicles has not been as rapid as was expected, and causes have existed that were not foreseen and that were not generally understood. Some vital reason seems to have prevented the rapid development and general adoption that at one time seemed assured. Was it the element of cost? Two important conditions stand out prominently in connection with electric road vehicles. These are, first cost and cost per mile of operation. It is not my purpose to discuss the first, as there are endless variables entering into the question, and it is doubtless true that the prices will gradually decrease. This part of the problem is always found to be self-correcting, and even to-day, with the electric, the cost per pound of vehicle complete, is lower than other and far less available and pleasurable systems.

The cost of electric power for automobiles has been demonstrated in Paris to be less than with any other power system, and surely this factor is not the one now preventing the wide adoption of electric vehicles. In a paper before the American Institute of Electrical Engineers, G. F. Sever and R. A. Fliess, of Columbia University, give results of extended trials with electric delivery service in New York City. It is shown that with present power and rolling friction factors, there is effected a saving of nearly 2½ cents per car-mile over horse service, and with the capacity of many more miles per

* Read at the meeting of the National Electric Light Association of Chicago, May 24th, 1900.—*Western Electrician.*

day than with horses. With a daily service of 36 miles, a saving of 356 hours per year of actual delivery service per vehicle is effected. The average horse was found to have a capacity for three hours' work per day at the rate of seven miles per hour. The authors state: "The figures given above speak for themselves, and would appear to be most effective argument in favour of adopting electric automobile delivery service."

A popular notion exists that carriage batteries and electric batteries are charged with a certain number of miles. It requires only a second thought to see the error or delusion embodied in this idea. It is evident that a battery when fully charged contains, not miles, but electrical power, (*sic*), which may be expressed in horse-power and which is proportional to the size and capacity of the particular battery in question. With this in mind, it will be readily seen that the statement that a carriage contains a capacity to run a given number of miles would only be true when a certain standard pavement or roadbed is considered, because it is found that it requires very much more battery power to drive a carriage a mile on a soft, uneven, and hilly road, than it requires on a smooth, hard, and level road. It should always be understood that a standard pavement or roadbed is considered.

(*To be concluded.*)

DINNER TO THE AMERICAN ELECTRICAL ENGINEERS.

On Monday last, in accordance with the programme published in our last issue, a number of members of the British Institution entertained members of the American Institute of Electrical Engineers to dinner at Prince's Restaurant, Piccadilly. Prof. Perry, President of the home society, took the chair; there were 76 present in all, about 30 of whom were guests, including several ladies.

After the excellent repast provided had been disposed of, the President briefly proposed the toasts of "The Queen," and "The President of the United States"; Prof. Perry proved to his own satisfaction that Mr. Carl Hering, President of the American Institute, and Mr. McKinley himself, although born in America, were not Americans but "Uitlanders." In fact, the Professor claimed Mr. McKinley for an Irishman, even as himself, and gave an analysis of his own somewhat mixed ancestry.

Mr. Cunynghame, C.B., proposing "The United States," expressed the sincere regard which he had entertained towards the American nation from the earliest times. Making a long and somewhat tedious speech on the "grave dangers" through which this country had passed during the last four or five years, the speaker foretold the end of the Empire owing to the exhaustion of our coal, hoped that we should annex no more territory, prayed for an alliance with the United States, and depreciated our English ladies in comparison with Americans. Truly, Mr. Cunynghame would do well to emigrate to the U.S.A.

In accordance with an invention of Prof. Perry's, according to which *two* persons proposed each toast, Mr. Raworth followed, and expressed his admiration of the Professor's "complicated blood"; he also pointed out the excellent results produced by fusion of races, as evidenced in the U.S.A.

Replying to the toast, Mr. Carl Hering regretted that many of the American visitors, who did not know in time of the amiable intentions of the British Institution, had already gone to the Continent, and went on to point out that the first large alternator, the adoption of direct coupling, and high-voltage transmission, all originated in this country.

Prof. Crocker, who was formerly an Anglophobe (having been born on the Fourth of July), declared his complete cure, thanks to a tour through the Empire. Experience taught him that the affinities between the American and English nations were very close, and far outweighed their differences.

Mr. Mailloux also replied, and compared the President's invention with the Scott system—two-phase to three-phase—as two proposed on the primary side, and three replied on the secondary. Expressing his cordial appreciation of the hospitality manifested towards the visitors, he also made graceful and touching references to Newton, Faraday, Maxwell, and—the Newton of electricity—Kelvin.

Mr. Pope, proposing the toast of "Electrical Engineering," remarked on Prof. Perry's innovation; in the U.S.A. the phrase goes, "Try it on the dog," and in this case the guests were the subject of experiment! Another saying (by a witty member of our Institution) was—"Any fool can make an invention, but it takes a genius to put it on the market," and Mr. Pope, amid laughter, accepted the President's invention, and undertook to put it on the market. He had at first supposed that the programme provided for "two days in the woods around London," and looked forward to buffalo hunting, &c., but discovered that a type-writer had made a mistake for "*works*." Mr. Pope proceeded to remark on the temperature in the sub-stations on the C.L.R., which burst the thermometer, but recollecting the toast, said that of all electrical applications, telegraphy was the most important. He used to be a telegraph engineer. One could walk if an electric railway were not available; but how would the gentlemen of New York know when it was raining in London, so that they should turn up their trousers, if it were not for the telegraph? Alluding to the London climate, as it was last week, the speaker passed on to the London streets, which he would not wish altered. Daniel Webster said: "There is always room at the top"; in London there is always room at the bottom—if 130 feet down, why not deeper still? Mr. Pope concluded by prophesying that the spread of electrical engineering in America would tend to improve municipal government there.

Mr. Mordey was taken aback to find that the two proposers (of whom he was one) were not to speak in parallel and synchronously, as he had supposed; he ascribed the Central London Railway to English financiers and American engineers, and referred to the undertaking as a "new" application of electricity, points to which we refer elsewhere. Mr. Mordey also claimed Elihu Thomson and Kennelly as Englishmen, Carl Hering as a Scotsman, and Steinmetz as a German. Referring to Tesla as another immigrant, Mr. Mordey accorded to him the unique distinction of having lectured twice on the same subject before the Institution; but so did Marconi.

Replying to the toast, Prof. Silvanus Thompson pointed out how the *self*-induction of two separate circuits (or Institutions) becomes *mutual* induction when they are brought together, and suggested that the visitors should go to see the stationer's shop in Blandford Street, where Faraday served his apprenticeship, as well as to Paddington electricity station to see the first two-phase direct-coupled alternator ever built, dating from 1883. Prof. Thompson also paid a graceful compliment to American hospitality—all stars, no stripes.

Mr. Kennelly remarked that the position of co-respondent, in which he found himself, was not so uncomfortable as he had supposed. Referring to the bright future before electrical engineering, he pointed out that we all have the same Lares and Penates—we all worship the same ampere—Her Majesty's ampere, which dwells at the Board of Trade—and Her Majesty's ohms!

Mr. Ward Leonard proposed the health of the President, in reply to which Prof. Perry paid a well-deserved compliment to the excellent arrangements made by Mr. McMillan, who did all the work.

The company then adjourned to the drawing room, where more general conversation was possible, and did not break up until a late hour.

The whole of the proceedings constituted a great success in every way, and all seemed to thoroughly enjoy the function.

VISIT OF THE ELECTRICAL ENGINEERS (R.E.) VOLUNTEERS TO IRELAND.

By One of Them.

Fifty members of this corps have just had the unique experience of being the only members of the Volunteer force of this country who have been sent to Ireland on duty.

Some few weeks ago the War Office asked the Corps for 50 volunteers who would be willing to serve at Cork during the Naval Manœuvres, in lieu of their annual training, and, needless to say, there was great competition among the members to be one of the number.

The writer, who was fortunate enough to be included in the first contingent, proposes giving the readers of the Electrical Review a short account of their experiences during the week.

On Friday, July 21st, 25 non-com. officers and men, under Company Sergt.-Major Poynton, paraded at Paddington, and proceeded by the 6.20 p.m. train to New Milford, going thence by the Great Western Railway ss. *Gazelle* to Waterford, at which place it was intended to get breakfast, but, owing to the boat being late, there was no time to do more than catch the train to Cork.

The thing which impressed us most on the journey was the constant and unending source of joy which the railway officials took in causing one to wake with a start from a much-needed nap to dive into the deepest recesses of kitbag or haversack, or any other place where it was not, for one's ticket; in fact, we began to fear if there would be anything left to show when we got to our destination.

It was in this connection that we gained our first experience of Irish repartee on native soil, for when we remonstrated with a ticket collector on the wilful destruction of good paper by punching so many holes in it, he told us that it was like the way Kruger had put holes in us, no doubt taking us for regulars.

However, we at last reached Queenstown, where we were met by Capt. Hopkinson, who had preceded us, and was in command of the party, and after having some tea, we crossed over to Fort Camden, and there did ample justice to a good square meal, which was most acceptable, the time then being 4 p.m. on Saturday.

We were then detached by Capt. Hopkinson into two parties, C. S.-M. Poynton being left at Fort Camden with

12 men, and the remainder, under a sergeant, being sent to Fort Carlisle, which was on the other side of the harbour. This party went under canvas, while the one left behind was housed in the fort.

We found ourselves in the midst of glorious country, with a magnificent view of Cork Harbour, Queenstown lying on the opposite shore with Spike Island, in the foreground of which is situated the convict station. Had we tried we could not have chosen a more beautiful or healthy spot in which to spend a holiday, and we were also most fortunate in the weather, which was just of that nature which allows one the chance of being able to make the most of a holiday without being too hot.

Our work consisted entirely in running the searchlights in the harbour with the necessary plant, and it had been arranged that we should be absolutely, to put it plainly, "on our own" and not mixed with the regulars, but should take shifts alternately with them, there being two each night, viz., from dusk to midnight, and from midnight to dawn.

This, of course, gave us the opportunity of showing that we were quite capable of taking sole charge of all the searchlight work in case of necessity.

The plant comprised: At Fort Camden, four Hornsby-Akroyd 25-H.P. oil engines driving four two-pole undertype dynamos, by Messrs. Scott & Mountain, supplying current for four 36-inch projectors fitted with Schuckert automatic lamps, three of which were always kept running, one being a standby. On the other side, at Fort Carlisle, we had a steam plant consisting of two Robey loco. type boilers supplying steam at 100 lbs. to three perpendicular enclosed engines direct coupled to three dynamos, similar to those at Fort Camden, as also were two of the projectors, the other one being fitted with a hand-feed lamp. Here, again, one was always kept as a standby.

During the daytime, with the exception of cleaning up the plant on each alternate day, we could do much as we liked, and several of our party made pleasant excursions to Cork and other places, including Blarney Castle, where they took good care to embrace the Blarney stone in the orthodox manner.

On Wednesday, the 25th, we were paraded for a complimentary inspection by General Harrison, Inspector-General of Fortifications, with Colonel Beresford as A.D.C.

The General told us he was pleased to have the opportunity of congratulating us on the efficient way in which our work was being done.

At the end of the week we were formally inspected in marching order previous to leaving, by Captain Palmer, the officer commanding the forts. In addressing us he spoke in the most complimentary manner of our work, telling us that we had been doing, and doing thoroughly and in a most workmanlike manner, exactly the work we should be called upon to do in case of war, and in doing which we should be of inestimable value in helping the regular forces—in fact, he said, he did not see how they would be able to get on without us—at the same time he expressed a strong hope that he might see us there in future years on like occasions.

We left Fort Camden at 3 p.m. on Saturday, the 28th, the feature of the journey being a mad procession of jaunting cars laden with electrical engineers from Waterford station to the boat, which we found had actually cast off, but, fortunately for us, put back to take us aboard.

We heard here that the second contingent had landed and gone to Cork.

Most of the night was made hideous—at least, that is probably what the passengers down below called it—by an impromptu concert given by ourselves on deck.

However, we at last found ourselves at 9.30 p.m. on Sunday at Paddington, after the most successful camp we have yet been to.

One of the most pleasant features of the camp, as indeed has always been the case in past years, was the excellent feeling which existed between the Regular Engineers and ourselves. One cannot speak too highly of the manner in which they always seem to go out of their way in order to give us a helping hand here and a hint there.

There can be no question of the success that has attended this corps since its foundation by our late Officer Commanding, Major Hopkinson, and those who helped him, when one thinks that it is represented at the front by so large a percentage of its total number, and is at the same time quite capable of sending enough efficient men to work all the lights, &c., in any fort, as has just been proved. I think, however, that, considering the large number of young fellows in the electrical profession and the many advantages one gets from joining the corps, our numbers should increase even more rapidly than they do, and when our headquarters are finished, which we hope will be early in the year, and which it is proposed to fit up with a complete set of searchlight and submarine mining plant, we shall look to see our full strength reached in a very short time.

ELECTRIC TRACTION UNDER STEAM RAILWAY CONDITIONS.

The application of electricity to ordinary railways is a subject which is bound to attract the close attention of the highest intellects. In one form and another the matter has been talked over for years; and even the Institution of Civil Engineers, whose proceedings are always characterised by extreme soberness, has on occasion gravely considered proposals to convert steam railways to electrical methods. Among the "moderates" in electrical engineering, however, it is assumed that there are definite limitations to applying electricity to railways, for while it would on many local and branch railways prove economical and convenient, it would be totally inapplicable to trunk lines. Mr. Frank J. Sprague some few years ago, when discussing the larger problems of electric traction, stated that "electrical development will go on until the trolley system is almost as common as the turnpike. It will establish lines of communication which have not hitherto existed; it will build up new territory; it will act as a feeder to great trunk line systems, both for passenger and certain classes of freight work; and it will largely encroach upon special fields now occupied by the trunk lines. But when we depart from this class of service and take up what is essentially a trunk line system, there are many questions to be considered, and not alone those of the local and express service, but also a most important one which is rarely considered when electric railways are talked of. I refer to the trunk line freight service—that is, the transportation of goods in great bulk over long distances. One must remember that trunk lines as they now exist have been built up by a slow process, and that no very serious change from their existing conditions can be made, considered from the commercial standpoint, except after grave deliberation, and at very great expense."

With the foregoing views most engineers would be inclined to agree, but whether the developments of electrical science may not tend to modify the views of the "irreconcilables" on the trunk line question is at the moment difficult to say. In this country we consider it no mean achievement to have, in the year 1900, opened a third underground electric railway, and though the line itself is of supreme interest, its importance must be gauged by its influence on the managers of steam lines. Indeed, it is not too much to say that the Central London Railway will do much to convince railway sceptics that electricity can, under certain conditions, cope with continuous and heavy traffic. In America much experience has been gained in the operation of local lines by electricity, and not the least interesting feature of many is the running of electrical and steam trains over the same system. Some little time ago the subject of electric traction under steam railway conditions was brought before the American Institute of Electrical Engineers by Mr. Edward C. Boynton, and as some of the most notable of American traction men discussed the views of the author, some very interesting conclusions may be drawn. Mr. Boynton's remarks were obviously based on his experience on the New York and New Haven Railroad, and as some of the problems to which he specifically addressed himself have no doubt cropped up on this railway, it will be useful to consider some of them.

One does not go far before arriving at the opinion that though our American friends may occasionally suggest the application of electricity to main lines, there are still many

matters connected with the operation of a local or branch electrical line on which there is, by no means, unanimous practice. It is assumed in Mr. Boynton's paper that on many steam railroads there are certain sections which present the most favourable conditions for the substitution of electricity for steam as a motive power. These conditions are the result of increasing density of population, and mean that better and cheaper transportation facilities are needed by the public than are provided by the steam road. It is not necessary to attempt to convince our readers that many of the railway systems running into London will be under the necessity of considering the question of adopting electricity on certain sections; in fact, it has been recently reported, though how much truth there is in the statement we do not know, that the Great Eastern Railway are considering electricity for future suburban lines. Whenever a steam line contemplates the adoption of electrical working, it has several methods to choose from, they are defined by Mr. Boynton as follows: (1) The purchase of electric locomotives of sufficient power and weight to haul its standard passenger coaches. (2) The equipment of a number of its standard coaches as motor cars. (3) The purchase or building of a sufficient number of special light passenger coaches, some of which are equipped as motor cars, and the withdrawal of its standard coaches entirely from this service. (4) Shall freight be hauled by electricity or steam? The first three considerations are of the greatest importance to the directors of the Metropolitan and District railways at the present moment, and it is interesting to summarise the views put forward in the discussion to which we have alluded.

It is claimed that the principal advantage of electric locomotives lies in their ability to perform similar work to a steam locomotive, and this is occasionally a strong recommendation to railway managers. They must be provided with sufficient power to haul at least double the average train. The cost of repairs on an electric locomotive is probably very low, and another notable advantage is that switching and controlling devices are very much simplified. On the other hand, there is by this arrangement considerable dead weight.

The second method of equipping a line would be the equipment of standard coaches as motor cars, each motor car of which would draw a train of from four to five coaches, while the most important modification of this would be making all the cars, or some portion of them, motor cars, and this would no doubt be equivalent to a multiple unit system; in fact, Mr. Sprague defines the system which is so largely identified with his name, as the equipment of two or more cars of a train, and which are simultaneously controlled.

There is little doubt that the multiple unit system or a modification of it is finding distinct favour among electrical railway men. On this point it is interesting to quote the remarks of Mr. Sprague made at the discussion on Mr. Boynton's paper: "The Liverpool Overhead Railway operates at present three car trains, with motors on the front and back car. The Waterloo and City Railway operates three and four-car trains with motors on the front and back car. The Union Company, of Berlin, has recently submitted a project to the Minister of Public Works proposing the change over from the present steam system to an electric system, working as many as 12 cars in a train, each car being equipped with two motors of 150 H.P. each. The new Berlin Elevated Railway, of which Messrs. Siemens & Halske are the prime movers, are considering the operation of four and five and even up to ten-car trains, and they have had under consideration all sorts of methods—four-car trains with three motors on the front and on the back car; five-car trains with two motors on the front and back car; ten-car trains with two motors on the first and rear car and two motors on a middle car, and a full multiple unit system. The new Boston Elevated road will have an equipment of two 150-H.P. motors per car, and operate them in from two to five or six-car trains, all under a common control. The Brooklyn Elevated will operate from three to five-car trains, with two and three motor cars in a train, and contemplate eventually equipping every car, all under a common control." No doubt the general practice is towards grouping units and controlling from one common point, and though the arrangement scarcely makes for simplicity as compared, say, with an electric locomotive, it does undoubtedly possess some special advantages in the way of acceleration, and in permitting an adjustment in the size of trains according to the traffic density. It is not, however, suitable for all conditions, and Mr. Sprague does not claim that. Quite a remarkable feature in electric railway practice is the size of the equipment, a four-motor car representing in some cases 800 H.P., this being the maximum horse-power which can be placed under a standard coach on trucks and wheels which do not necessitate any other changes in the existing standards of steam practice.

Although until later years the secondary battery was more associated with English than with American practice, it is interesting to note how largely it is now appreciated by American engineers; Mr. Sprague values it so highly as to say "its use on the South Side Elevated in Chicago, on which I have 180 cars in operation, the experience on the Metropolitan road in this city (New York), and the general introduction on a large number of other roads and central stations, primarily for the purpose of equalisation of load and for taking a small portion of the peak load at certain hours, warrant the statement that it is certain to be a feature in railway development."

BOILERS FOR OUR NAVY.

Signs are not wanting that the recently appointed Boiler Committee, the composition of which we referred to last week, is attracting the attention of boiler makers, and especially of makers of water-tube types. An evidently inspired article in the *North British Daily Mail*, of Glasgow, contains an account of a visit to the works of the Babcock & Wilcox Company at Renfrew. It is a piece of special pleading for this boiler, as compared with the Belleville. Evidently even the makers of water tube boilers, glad enough at one time to have any water-tube boiler taken up, are beginning to realise what we have so persistently pointed out, that the danger which threatens our boasted Navy is not necessarily the adoption of the water-tube boiler, but of *a* water-tube boiler.

In this article it is stated that the Babcock & Wilcox boiler is employed in several of the ships of Messrs. Wilson, of Hull. When Mr. Allan, M.P., rises in the House and speaks the truth about boilers, Mr. Wilson, of Hull, gets up and challenges his statements, for he claims that his firm use the water-tube boiler. Mr. Wilson thereby may do mischief, albeit unintentionally. As he is a large shipowner, the public conclude that if he uses the water-tube boiler it must pay him to do so, and the boiler must therefore be all right. Now we cannot suppose that Mr. Wilson would be deliberately misleading. All the same, he may work harm, because his words may have lulled into a feeling of security many who would otherwise have helped in the agitation against the Belleville boiler. A correspondent of a daily paper calls attention once more to the extreme filthiness of the Belleville boilers. We may suppose that the Naval manœuvres are not carried out without the best Welsh coal, and that the filth is due simply to the water-tube boiler. This question of smoke is one that troubles all water-tube boilers, but though it implies bad furnace arrangements, it is not a danger or indicative of danger, except so far as smoke may be undesirable on account of its visibility to an enemy.

The Niclausse and the Babcock boiler have both been named in connection with the Navy, in which they have had a limited trial. The Niclausse boiler is a derivation from the Field tube principle, and should prove safe. The Babcock marine boiler differs much from the familiar land type, being much shorter in the tubes, and the lower tubes being much more widely spread than the upper tubes with the idea of assisting combustion, but neither of these boilers appears to be any better in principle as regards smoke than is the Belleville. They are all hopeless in this respect for bituminous coal, and doubtful for any coal that will smoke. Bertin gives the evaporation of the Babcock boiler with forced draught and closed stokehold as only 7 lbs., or as 8·5 lbs. from and at 212° F.

The Niclausse boilers of the French ship *Friant* showed a very low efficiency at first, but were proved to require a very thin fire, and are stated by Bertin to have evaporated nearly 10·5 lbs. from and at 212° when burning coal at the rate of 25·3 lbs. per square foot of grate per hour. It is perfectly obvious that, no matter how bad all water-tube boilers may be as regards smoke production, there are others than the Belleville, and at least some of these others are safe, and are constructed with some regard to correct principles internally as far as regards circulation. We think that the seventh member of the Committee, if not yet chosen, might well be selected from the ranks of the Boiler Insurance Companies. These societies have had opportunities of watching all the boilers of the last 40 years, from the so-called Howard Safety boiler, which was so very disastrous, down to the present day.

A German boiler, also derived from the Field tube, is the Dürr boiler, that was fitted to the *Ersatz-Freya* of 5,600 tons, to be tried against Belleville and Niclausse boilers fitted in sister ships. We have not heard if these tests have yet been made.

The one universal feature of all the water-tube boilers is the entire neglect of the necessities of combustion which they all exhibit. The predominating desire of the designer's heart appears to be simply to crowd all the heating surface as closely and thickly as possible upon the half-consumed fuel.

CURRENT SPECIFICATIONS.

XXV.—STOCKPORT ELECTRIC TRAMWAYS.

SUMMARY.

Extent of Contract.—Supply of 20 completely equipped electric tramcars.
Type of Car.—Double deck.
Seating Capacity.—Offers to be made for cars to seat 40 to 50 passengers and also 50 to 60 passengers.
Gauge of Line.—4 feet 8½ inches.
Type of Truck.—Optional with contractor.
Specified Sizes of Motors.—Alternative offers to be made for cars fitted with two 25-H.P. and two 35-H.P. motors.
Type of Brakes Specified.—In addition to the usual brake an air brake worked from axle or other efficient form of special brake to be supplied.
Specified Date of Delivery.—Ten complete cars in 12 months from date of order; five six months latter; five 12 months later.
Penalty for Late Completion.—£5 per week.
Specified Terms of Payment.—Ninety-five per cent. one month after delivery of each instalment of cars; 5 per cent. six months after completion of contract.
Stipulations as to Removal of Foreman.—None.
Stipulations as to Wages Paid to Workmen.—Satisfactory. See comments below.
Arbitration.—None allowed—see notes below.
Date for Receipt of Tenders.—August 31st, 1900.

This is one of the most reasonable specifications we have examined for some time. It has been prepared by Mr. J. Atkinson, the borough surveyor. As stated above, it asks for 20 fully equipped electric tramcars, none of which are really wanted before the expiration of 12 months; although, if earlier delivery of the first half can be guaranteed by the tenderer, the point will receive favourable consideration. The specification was issued in the middle of July, and tenders are not due until August 31st, so that there is ample time to prepare offers. This is a point which consultants often forget; they take a long time themselves to draw up the specification, but they expect manufacturers to be in a position to prepare offers in the course of a few days. This practice of giving little time for the preparation of tenders re-acts unfavourably to the real interest of the purchaser, for it prevents manufacturers giving close attention to the wants of the buyer, and making those alternative offers which often are so greatly to the buyer's advantage, as they minimise the proportionate charge for patterns by employing manufacturers' standard apparatus.

The claim dealing with penalty for late completion is of a satisfactory nature.

It reads :—

In case of any default on the part of the contractor in performing this contract, or any stipulation thereof, the sum of £5 per week shall be forfeited and paid by the contractor to and retained by the Corporation by way of liquidated and ascertained damages, and not by way of penalty, for each and every week during which such default shall continue, provided that this clause shall not be operative during such period as the borough surveyor may certify that such default has arisen from a general strike of workmen or unavoidable accident; and the borough surveyor may in such case grant such extension of time for the completion or performance of the contract as he may think proper.

There is nothing to object to in the stipulation regarding wages, which simply demands that :—

The contractor will be required to furnish the Committee with satisfactory proof that he pays the standard rate of wages and observes the standard number of hours, wherever such standard exists.

But the same cannot be said with reference to the provisions regarding the procedure to be adopted in case of disputes.

No provision is made for arbitration, the decision of the borough surveyor is to be final; and an otherwise fair-minded specification is rendered in its present form highly objectionable.

The clause states :—

If at any time during the progress or after the completion of the contract any disputes or differences shall arise as to the meaning or construction of this contract, particulars, general conditions, or the tender or specification, or as to the quality of the materials employed, or as to any matter of charge or account between the Corporation and the contractor, or as to any other matter or thing connected with the contract, *such disputes or differences shall be referred to and finally settled by the borough surveyor for the time being of the Corporation, whose decision shall be final, binding, and conclusive on both parties.*

Again we would press upon tenderers the importance of insisting upon the insertion in the final contract of the following or a similar clause providing for the settlement of a dispute by an independent authority :—

In case any difference or dispute shall arise between the purchaser, or his engineer on his behalf, and the contractor, either during the progress of the works or after the determination, abandonment, or breach of the contract, as to the construction of the contract, or as to the reasonableness of any extra charge, or as to the withholding by the engineer of any certificate to which the contractor may claim to be entitled, then either party may, within 72 hours, but not later, give to the other notice in writing of the existence of such dispute or difference, and such dispute or difference may be referred to arbitration, which arbitration shall be deemed to be a submission to arbitration within the meaning of the Arbitration Act, 1889.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS, 1900.

Compiled expressly for this journal by W. P. Thompson & Co. Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, Manchester and Birmingham, to whom all inquiries should be addressed.

13,622. "A device for lessening disablement of etherically steered torpedoes, incurred by interfering influences projected from an enemy." C. J. Varicas. Dated July 30th.

13,636. "Combined electric alarm switch and air-brake coupling." W. E. Cocks. Dated July 30th.

13,637. "An improvement in inductors or like apparatus having an oscillating armature." A. Schoeller. Dated July 30th.

13,639. "An improved electric motor." A. G. Bloxam. (La Societe Ch. Milde Fils & Co., France.) Dated July 30th.

13,643. "Improvements in wireless telegraphy." C. Marechal, J. Michel, E. Dervin. Dated July 30th. (Complete.)

13,652. "Improvements in and in the construction of electrodes." R. J. Gulcher. Dated July 30th.

13,656. "Improvements in and relating to the electrodes of accumulators and the manufacture thereof." R. W. James. (J. J. Heilmann, France. Dated July 30th.

13,661. "Improvements in tramcars, railway cars, or locomotives and the like, driven by electric or other motors." W. R. Renshaw. Dated July 30th.

13,679. "Improvements in holders for electrolytic incandescent lamps." B. M. Drake, E. G. Sheppard, and The Nernst Electric Light Company, Limited. Dated July 31st.

13,680. "Improvements in series resistances for electrolytic lamps." S. L. Powell and The Nernst Electric Light Company, Limited. Dated July 31st.

13,709. "Improvements in and connected with index arrangement for telephone subscribers." H. Oppenheimer. (Actiengesellschaft, Mix & Genest, Germany.) Dated July 31st.

13,720. "Improvements in methods of operating dynamo-electric machines." The British Thomson-Houston Company, Limited. (E. J. Berg, United States.) Dated July 31st. (Complete.)

13,721. "Improvements in systems of electric motor control." The British Thomson-Houston Company, Limited. (C. L. Perry, United States.) Dated July 31st. (Complete.)

13,722. "Improvements in contact devices chiefly designed for use in connection with electrical counting or recording devices." A. W. Staveley and I. H. Parsons, trading as Gent & Co. Dated July 31st.

13,732. "Improvements in electricity meters." W. M. Mordey and G. C. Fricker. Dated July 31st.

13,751. "A new or improved automatic device for the safe operation of electric conductors, with or without guard wires." C. SINTAS and E. E. SCHULTZ. Dated July 31st. (Complete.)

13,758. "Improvements in incandescent electric safety lamps." F. H. HILL. Dated July 31st.

13,765. "Improvements in automatic electric block systems for railroads." J. SHOECRAFT and C. C. GARDINER. Dated July 31st. (Complete.)

13,786. "Self-acting charge and discharge indicator for accumulators and similar apparatus." H. W. HELLMAN. Dated August 1st. (Complete.)

13,805. "Improvements in insulating supports for electrical conductors." G. WRIGHT and C. AALBORG. Dated August 1st. (Date applied for under Patents, &c., Act, 1883, Sec. 103, January 2nd, 1900, being date of application in United States.)

13,810. "Improvements in trolleys for electric traction, having three wires for triphase currents." A. BOSSHARDT. (L. Gerard, Belgium). Dated August 1st.

13,811. "Improvements relating to underground electric conduits." H. HILLISCHER. Dated August 1st.

13,816. "Improvements in or connected with storage batteries." W. O. ROOPER. Dated August 1st. (Complete.)

13,820. "Improvements in or relating to starting switches and automatic controllers of electro-motors." E. F. MOY and P. H. BASTIE. Dated August 1st.

13,822. "Improvements in alternating current electro-motors." F. M. LEWIS. Dated August 1st.

13,839. "Improvements in glow bodies and heaters for electrolytic incandescent lamps." B. M. DRAKE and THE NERNST ELECTRIC LIGHT COMPANY, LIMITED. Dated August 2nd.

13,860. "Improvements in controllers for electric motors." T. S. PERKINS. Dated August 2nd. (Date applied for under Patents, &c., Act, 1883, Section 103, January 13th, 1900, being date of application in United States.)

13,873. "Improvements in electric switches." G. H. WHITTINGHAM. Dated August 2nd. (Complete.)

13,874. "Improvements in automatic circuit controllers." G. H. WHITTINGHAM. Dated August 2nd. (Complete.)

13,892. "Process for the production of heating bodies for exciting electrical incandescence bodies made of second-class conductors." V. I. FEENY. (Allgemeine Elektricitäts Gesellschaft, Germany.) Dated August 2nd. (Complete.)

13,901. "Improvements in electrical demand indicators." J. R. DICK and THE REASON MANUFACTURING COMPANY, LIMITED. (Partly by A. Wright, on the High Seas.) Dated August 2nd.

13,951. "Improvements relating to electric muffles or furnaces." J. WEISS. Dated August 3rd.

13,962. "Improvements in electric signal registering systems." C. A. JENSEN. (The Yargae Signalphone Manufacturing Company, United States.) Dated August 3rd.

13,963. "Improvements in and relating to cypher code systems for use in transmission of cable, telegraphic, and other forms of written messages." E. F. CASSEL. Dated August 3rd. (Complete.)

13,966. "Improvements in Röntgen ray tubes." THE BRITISH THOMSON-HOUSTON COMPANY, LIMITED. (E. Thomson, United States.) Dated August 3rd. (Complete.)

13,967. "Improvements in systems of electrical distribution." THE BRITISH THOMSON-HOUSTON COMPANY, LIMITED. (E. W. Rice, jun., United States.) Dated August 3rd. (Complete.)

13,968. "Improvements in systems of electric motor control." THE BRITISH THOMSON-HOUSTON COMPANY, LIMITED. (A. G. Davis, United States.) Dated August 3rd. (Complete.)

13,969. "Improvements in insulated electric conductors." THE BRITISH THOMSON-HOUSTON COMPANY, LIMITED. (W. Le R. Emmet, United States.) Dated August 3rd. (Complete.)

13,970. "Improvements in armatures for dynamo-electric machines." THE BRITISH THOMSON-HOUSTON COMPANY, LIMITED. (C. P. Steinmetz, United States.) Dated August 3rd. (Complete.)

13,971. "Improvements in rectifiers for alternating electric currents." THE BRITISH THOMSON-HOUSTON COMPANY, LIMITED. (E. Thomson, United States.) Dated August 3rd. (Complete.)

13,972. "Improvements in systems of electrical distribution." THE BRITISH THOMSON-HOUSTON COMPANY, LIMITED. (A. D. Lunt, United States.) Dated August 3rd. (Complete.)

13,973. "Improvements in insulated electric conductors." THE BRITISH THOMSON-HOUSTON COMPANY, LIMITED. (W. Le R. Emmet, United States.) Dated August 3rd. (Complete.)

13,974. "Improvements in rail bonds for electric railroads." THE BRITISH THOMSON-HOUSTON COMPANY, LIMITED. (J. R. Lovejoy, United States.) Dated August 3rd. (Complete.)

13,975. "Improvements in systems for controlling electric motors." THE BRITISH THOMSON-HOUSTON COMPANY, LIMITED. (C. E. Barry, United States.) Dated August 3rd. (Complete.)

13,999. "Improvements in arc lamps." L. BENARD. Dated August 3rd.

14,037. "Improvements in or relating to electrical transmission gear for motor cars and other machinery." H. T. DAWSON and H. A. DAWSON. Dated August 4th.

14,053. "A lightning protector for telephones." C. R. CORMAC. Dated August 4th.

14,054. "Improvements in indicators for electric bells and the like." J. SAX & CO., LIMITED, and J. AIRD. Dated August 4th. (Complete.)

14,063. "Improvements in and connected with combined switches and fuses." G. C. PILLINGER and A. VANDAM. Dated August 4th.

14,067. "Apparatus for generating and utilising electric energy." W. S. SIMPSON. Dated August 4th.

14,069. "Improvements in lightning arresters." W. L. WISE. (Actiengesellschaft Elektricitätswerke vorm, O. L. Kummer & Co., Dresden.) Dated August 4th. (Complete.)

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. THOMPSON and Co., 322, High Holborn, W.C., and at Liverpool, Manchester, and Birmingham, price, post free, 9d. (in stamps).

19,788. "Improvements in motor-driven road vehicles and in electric motors therefor." W. A. Crowdus. Dated September 17th, 1898. Relates to various improvements in the underframe, steering and controlling arrangements, construction of the motor and driving gear and battery contacts of an electrically propelled vehicle. The electro-motor has two armatures on independent shafts in alignment with each other, which armatures are in series and rotate in a single magnetic field, or its equivalent common to the two. One armature drives the wheel on one side of the vehicle, and the other drives the wheel on the other side. By this arrangement there is produced electrically the same effect as by a mechanical balance driving gear. In one example the field magnet is of the armour-clad type, but in a modification each armature may serve as a magnet yoke to the field of the other. Each armature shaft may drive its own wheel by either toothed or friction pinions. In the case of friction gear, the motor shaft is supported in an eccentric collar which may be rotated slightly so as to cause it to exert any desired frictional pressure, and is then fixed. Means are provided for automatically establishing electrical connection between the batteries and the vehicle when the battery trays are placed in position, which are designed to be protected from the acid fumes from the batteries. A stud on the battery tray is pushed through a perforation in a vulcanized rubber sheet and engages a spring contact. 8 claims.

19,824. "Improvements in means or apparatus for facilitating calculations relating to secondary electrical batteries." M. B. Cotterell. Dated November 23rd, 1898. The apparatus is for performing calculations in reference to secondary electric batteries, and consists of two cards sliding upon one another, the upper one being marked with a logarithmic scale of voltages and with other data and instructions regarding certain types of batteries, and the lower one with scales, the former logarithmic of number of lamps and cost respectively. The scales on the lower card show through apertures in the upper. As an example of the use, if the voltage and number of lamps in a circuit are decided upon, the number of volts on one scale is brought over the number of lamps on the other scale. Then the nearest size of battery cells suitable is indicated under the arrow together with cost of working and number of cells at the voltage desired. 1 claim.

19,827. "Improvements in electric arc lamps." B. H. Pomeroy. Dated September 19th, 1898. Relates to arc lamps. In an enclosed arc lamp for alternating current, the upper carbon passes through a flat clutch, which is hung by a link from a collar on a vertically movable tube, the free end of the plate resting on the cover of the arc-enclosing globe or other stop, when the tube descends sufficiently. The tube is attached to a cross-piece, the longer arm of which carries a dash-pot on a stationary piston, while the shorter arm rests on a spring on the laminated core of a pair of solenoids. The retardation due to the dash-pot is increased by its lateral position, which causes slight binding. The solenoids have their end plates bored to slide on rods and are supported by springs to reduce the production of noise. A straight laminated armature is fixed on the frame above the solenoids. A series choking coil is mounted in the lamp and provided with a number of connecting eyes, to any of which a flexible connection may be secured, so as to include more or less of the coil in circuit to adapt the lamp for different pressure. 7 claims.

19,828. "Improvements in electric arc lamps." B. H. Pomeroy. Dated September 19th, 1898. Relates to arc lamps. A clutch for an upper carbon consists of jaws carried by two levers which are pivoted on a plate and are linked to a cross-piece on a tube movable by a solenoid. The plate rests on the top of the arc-enclosing globe, and causes the clutch to release the carbon when the tube descends sufficiently. Contact between the upper carbon and the tube is maintained by metal balls placed on an inclined plane in an annular space in the cross-piece. Contact with the tube is maintained by a finger. A variable series resistance consists of bare wire over which an insulated contact shoe is movable by a screw and a head, a flexible connector being attached to the shoe. 4 claims.

19,855. "Improvements in the manufacture of electrodes for electric accumulators." H. H. Lake. (Sec. Roger & Rathlef.) Dated September 19th, 1898. Positive plates are made from grids of antimonial lead which are soaked in sulphuric acid, then covered with red lead, and again soaked in sulphuric acid. Negative plates are constructed in the same way, except that the plates are covered with a mixture of one part of red lead to five parts of litharge. 2 claims.

19,875. "Improved joint for telegraph and other wires conveying electricity." H. W. Nojid. Dated September 19th, 1898. Relates to couplings for telegraph and like wires. The wires to be joined are placed in a sleeve having a central opening which is then filled with solder. The sleeve and wires should be cleaned or coated with solder or the like before use. The ends of the wire are preferably bent up. 4 claims.

19,913. "Improvements in arc lamps." W. G. Hoys. (Manhattan General Construction Company.) Dated September 20th, 1898. Relates to an enclosed arc lamp provided with clutch regulating mechanism. A iron frame consisting of discs connected by two uprights is suspended by a tube screwed into it and having an eye at the upper end. A brass tube conical iron core brass cylinder and ring are secured in the frame by a screwed ring, which is inserted by using a cup as a key, the cup being inverted from its proper position and pins on it entered in holes in the ring. The regulating coil is supported by three feet on the ring and is somewhat larger than the cylinder so that air passes between them. An iron core slides between the tube and cylinder which serve as a dashpot. The core carries a hollow conical clutch containing three balls which project through holes in a loose tube into contact with the upper carbon. The frame of the lamp carries an insulating ring, and into this is screwed another ring carrying tubes, a connecting ring, and latches. The latches engage under the ends of a cross bar carrying the lower carbon holder and arc-enclosing globe. The latches are released by raising a cross bar by a handle in opposition to a spring; an inner rod with a handle enables the cross bar to be raised into engagement with them. 32 claims.

19,940. "Improvements in circuit breakers for three-wire electricity distribution systems." The British Thomson-Houston Company, Limited. (E. M. Hewlett.) Dated September 20th, 1898. Relates to means for breaking the main circuit in a three-wire system should one of the outer wires become grounded, or in case of excessive load on either side of the system. A second coil in shunt is added to the usual series coil of a circuit breaker. Normally this shunt circuit is broken. A relay or double wound magnet has its coils connected to the system. Should a ground occur, the current fail in one of the coils, the armature is attracted and contact made. The circuit breaker then operates. 7 claims.

19,959. "Improvements in systems of electrical distribution." C. F. Scott. Dated September 20th, 1898. Relates to arrangements for converting a three-wire single-phase system into a two-phase system for driving motors. A fourth conductor is added to the system, and this, with the balancing conductor, serves to carry a current in quadrature with the main current. The two-phase generator supplies the two three-wire circuits. To supply the motors a fourth wire is used. Instead of both circuits being supplied from one source separate generators may be used. 3 claims.

19,960. "Improvements in or relating to the conductors for electric railways." R. Bellfield. (Foreign Electric Traction Company.) Dated September 20th, 1898. Relates to conductors and rail bonds for electric railways and tramways on a third rail or sectional conductor system. The conductor or third rail which may be in duplicate and also in insulated sections is preferably of inverted V shape. At the insulated joints, wooden pieces with metal ends are inserted and the metal ends slide between the V rail and the clamp which is secured to the rail by a block and wedge. A stop and lug prevent the parts from coming apart. To connect the rails electrically, the block and clamp are made longer, and a wedge is inserted at each end, Plastic conducting material which may be on a copper strip, is interposed between the rail and block. The feeders may be soldered to extensions of blocks secured to the rails as described above. 3 claims.

19,972. "An electric switch worked by clockwork, or by electricity or both, or by hand independently of either." J. Hooper. Dated September 20th, 1898. Relates to switches adapted to be operated by clockwork or by electricity, or by hand. It consists essentially of a toggle joint connected at one extremity with a switch lever, and at the other gripping a projection on the end of a lever. The free end of the lever may be depressed by the cam operated by clockwork, or by means of an electro-magnet, or by hand. The toggle levers are suspended from the pivot and when the projection is moved from between the jaws, the rod is pushed forward and opens or closes the switch. 2 claims.

19,974. "Improved filaments for electric incandescent lamps." F. Dannert. Dated September 20th, 1898. Filaments are made from homogeneous mixtures of cellulose reduced to a paste with strong acetic acid and magnesium acetate or other salts of metallic oxides which possess great power of emitting light; the filaments are squirted and finished in an ordinary manner. The colour of the light produced is stated to depend on the salt used. 2 claims.

20,027. "Improvements in electrical apparatus for exhibiting and changing advertisements, signs, and the like devices." A. D. Douglass. Dated September 21st, 1898. Advertisements, signs, and the like are formed by means of incandescent lamps, each of which is held in a compartment of a board, any desired sign being formed by lighting certain lamps. To represent a word several boards are used, each board serving to represent a letter; but a word may be spelled out by means of a single board on which the letters composing the word are exhibited in succession. The wires connected with the several lamps which go to form the letter are united in terminals which are automatically thrown into circuit to form any letter by means of a switch device consisting of a drum having fingers or projections which operate contacts threaded on a rod. The drum is rotated by a motor, through pawl and ratchet gearing. 8 claims.